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UITGEGEVEN DOOR

Dr. MAX WEBER
Prof. in Amsterdam, Leider der Expeditie

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LEIDEN
E. J. BRILL
1910

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THE ACTINIARIA OF THE SIBOGA EXPEDITION

BY

J. PLAYFAIR Mc MURRICH

PART I

CERIANTHARIA

With 1 plate and 14 textfigures

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PART I

CERIANTHARIA

Before entering upon the special matter of this Report a few remarks seem necessary in explanation of the classification that has been adopted. The classification of the Anthozoa has undergone many changes as increasing knowledge of the structural peculiarities of the forms assigned to the group has revealed the manifold differences of their organization. An historical review of these changes is unnecessary here, as I have already (1893) given an account of the principal ones up to 1891, and a somewhat more thorough review, brought up to date, has recently been given by CARLGREN in the Anthozoa of BRONN's Thierreich (1908). Within recent years two classifications have been proposed as the result of extensive studies of groups of the Anthozoa and to these I desire to refer briefly, since the classification I am adopting here differs from both in certain particulars while agreeing in others. One of these classifications is that proposed by VAN BENEDEN (1898) and the other that of CARLGREN, in the work just cited. VAN BENEDEN, after a thorough discussion of the questions at issue, divides the Anthozoa into three great groups, the Zoanthactiniaria, Octactiniaria and Scyphactiniaria. The first of these groups is again subdivided into the Zoanthinaria, equivalent to HERTWIG's tribe Zoantheæ, and the Hexactiniaria which includes the Actiniaria and the Madreporaria. The Octactiniaria correspond to the group more usually known as the Alcyonaria; the Scyphactiniaria are divisible into three subgroups, the Ceriantharia, including the Ceriantharia and the Antipatharia, the Scyphomedusæ and the Rugosa. In tabular form the arrangement is as follows:

- Anthozoa
  - Zoanthactiniaria
    - Zoanthiniaria
    - Hexactiniaria
      - Madreporaria
      - Actiniaria
  - Octactiniaria
  - Scyphactiniaria
    - Ceriantipatharia
      - Ceriantharia
      - Antipatharia
    - Scyphomedusæ
    - Rugosa

To the principle involved in the first of these groups I would offer no objections, the Zoanthiniaria undoubtedly standing in closer phylogenetic relationship to the Hexactiniaria than to any of the other groups, and just as undoubtedly the Madreporaria are closely related to the Actiniaria, an idea suggested by HERTWIG and abundantly confirmed by recent studies of the soft parts and development of the coralligenous forms (see especially DUERDEN, 1902). With regard to the third group, however, I am entirely in disaccord. In the first place I cannot accept the close relationship that the arrangement predicates for the Ceriantharia and Antipatharia. Indications of affinity VAN BENEDEN finds in the presence in both groups of a longitudinal ectodermal musculature in the column wall, in the weak development of the mesenterial musculature and in the similarity in the arrangement of the principal mesenteries. The first two characters do not seem to me to be entitled to great importance, occurring and disappearing as they do in various groups of Anthozoa; the third is of significance. But is there similarity in this respect? VAN BENEDEN finds it by recognizing but three protocnemes in the Ceriantharia and in this I believe he is mistaken. I can see no reasons for regarding the fourth couple of mesenteries that appear in Cerianthan larvæ as other than protocnemes, and in later pages of this Report I shall present further evidence that is afforded by the development in favour of this view. I hope to show that the development of what I shall term the deuterocnemes in the Ceriantharia begins with the fifth couple of mesenteries and that, consequently, the members of that group take origin from an octamerous condition. Whether the Antipatharia really start from an hexamerous condition in which there are only three couples of protocnemes or not cannot be determined with certainty at present; we must wait for further light on the question, until, perhaps, a study of the embryonic development of some member of the group may offer data for a final conclusion. In the mean time it seems that any such close alliance of Ceriantharia and Antipatharia as VAN BENEDEN has proposed is inadvisable.

In the association of the Scyphomedusæ with the Ceriantharia, etc., I believe VAN BENEDEN has also fallen into error. Certainly these medusæ are more nearly related to the Anthozoa than to the Hydromedusæ, but instead of forming a subgroup of a subgroup of the Anthozoa they should be of equal value with that group. Their relationship traces back only to remote ancestors, to a stage before the differentiation of the Alcyonaria, Ceriantharia, etc., and to make the Scyphomedusæ equivalent to these is an imperfect expression of their phylogenetic affinities.

Finally, with regard to the Rugosae it seems probable that VAN BENEDEN himself, with the results obtained by DUERDEN (1905) now at his disposal, would materially alter his views as to their affinities and recognize their close relationship to the Zoanthactiniaria. The evidence which DUERDEN has presented as to their primary hexactinian characters seems well founded, and while I am not inclined to recognize for them so close an affinity to the Zoanthinaria as he suggests, nor yet to follow CARLGREN in including them among the Madreporaria, yet I believe there is reason for associating them with both these groups to the same extent that VAN BENEDEN associates the Zoanthids and Hexactinians.

I would accordingly do away with VAN BENEDEN's group Scyphactiniaria and frame a classification much more resembling that proposed by CARLGREN (1908), though differing from this in the position assigned to the Rugosæ. CARLGREN's classification is as follows:

- Anthozoa
  - Hexacorallia
    - Antipatharia
    - Ceriantharia
  - Octocorallia
    - Zoophytaria
  - Dodecacorallia
    - Zoantharia
    - Actiniaria
    - Madreporaria

In this, again, there is a closer association of the Antipatharia and Ceriantharia than seems advisable, nor should the Madreporaria be separated as distinctly from the Actiniaria as are the Zoantharia. Exception may also be taken to the nomenclature employed in both this and VAN BENEDEN's classification, on the ground that in the latter the terminations adopted do not sufficiently differentiate subgroups from groups, while in the former the term Hexacorallia is apt to be misleading both on account of its form and on account of the different sense in which hexamerism has been understood.

I would suggest an arrangement and nomenclature somewhat as follows, as representing fairly accurately our present information as to the affinities of the various groups.

- Anthozoa
  - Alcyonaria
  - Antipatharia
  - Ceriantharia
  - Zoanthactiniaria
    - Hexactiniæ
      - Madreporacea
      - Actiniacea
    - Zoantheæ
    - Rugosæ

This is essentially the classification I proposed in my paper on the Phylogeny of the Actinozoa (1891), except that the Edwardsiæ are now included in the Hexactiniæ and the Zoantheæ and Rugosæ are brought into closer relationship to the same group. This is in accordance with the views I have held as to the significance of the development of the mesenteries in the different groups. It seems quite certain, both from the comparative study of adult forms and from the embryological development, that a condition with eight mesenteries, developed in couples, is well marked in all the Anthozoan groups with the possible exception of the Antipatharia. Whether these are to be regarded as possessing only six mesenteries, comparable to the eight of the other groups, or whether they are to be regarded as modifications from a primarily eight mesenteried stage remains for demonstration, as does also the question of the significance of all the additional mesenteries occurring in such a form as Leiopathes. In the Alcyonaria the primary eight mesenteries are the only ones present, but in the Ceriantharia and Zoanthactiniaria additional mesenteries are added. In the former group these are always developed in couples, and this is also the case with the four mesenteries which succeed the

primaries in the Zoanthactiniaria, but while in the Ceriantharia these secondary mesenteries always retain the coupled condition, in the Zoanthactiniaria they form pairs with the lateral primary mesenteries, an hexamerous symmetry, with the mesenteries in six pairs, being thus produced. Finally in the Zoanthactiniaria a tertiary group of mesenteries is added, these mesenteries, as a rule, being developed in pairs.

It seems convenient to have distinguishing terms for these three groups of mesenteries. DUERDEN (1902[1]) proposed the use of the term protocnemes for the mesenteries constituting the six primary pairs of the Zoanthactiniaria, that is to say for the primary and secondary sets of mesenteries recognized above, and for the additional coupled mesenteries of the Ceriantharia and for the paired ones of the Zoanthactiniaria he employed the term metacnemes. This nomenclature is open to the objection that it disregards the significance of the eight mesenteried stadition found in the Alcyonaria and the Zoanthactiniarian larvæ and almost implies that this condition is a derivative from a six-paired one; further it makes the secondary coupled mesenteries of the Ceriantharia equivalent to the paired tertiaries of the Zoanthactiniaria. I would limit the term protocnemes to the eight primary coupled mesenteries, and for the secondary coupled mesenteries I would suggest the term deuterocnemes, while for the mesenteries which succeed these in the Zoanthactiniaria and which usually develope in pairs I propose the term zygocnemes. DUERDEN's term metacnemes might be employed either for these or for the deuterocnemes, but to avoid any confusion that might result from its application in a new sense it has seemed preferable to discard it.

CERIANTHARIA.

Our knowledge of the Ceriantharia dates from 1784 when SPALLANZANI gave a brief description of the form now generally known as *Cerianthus membranaceus*, regarding it as a somewhat aberrant Tubularia, to which genus RAPP (1829) also referred *C. solitarius*, first described by him. In 1804 RENIER, according to MENEGHINI (1847), had described *C. membranaceus* as *Actinia cylindrica*, thus associating it with the Actiniaria; in 1828 the same author redescribed it as *Moscata rododattila*; in 1830 DELLA CHIAJE assigned it to the genus Cerianthus under the name *C. cornucopiæ*; and in 1852 MILNE-EDWARDS and HAIME recognized a family Cerianthidæ, distinguished from the other Actiniaria by possessing a rounded aboral pole and including Ilyanthus as well as Cerianthus. It was not until 1854, however, that HAIME gave the first detailed account of the anatomical peculiarities of a Cerianthid, showing that it possessed many features distinguishing it from other Actiniaria, notably the arrangement of the tentacles and the occurrence of the mesenteries in couples instead of in pairs. VON HEIDER (1879) enlarged on HAIME's observations, principally by the discovery of sterile mesenteries alternating with the longer fertile ones which alone HAIME had observed, and the brothers HERTWIG (1879) confirmed this discovery and added the important conclusion that in all probability the formation of new mesenteries takes place only at one region of the body, namely, on either side of the dorsal median line. Correlating the results of their studies, the HERTWIGS recognized the fundamental distinctness of the members of the genus Cerianthus from the other groups of Actiniaria, and in 1882 R. HERTWIG established for them and their congeners the order Cerianthæ.

With the recognition of the distinctness of the Cerianthæ arose the question of their phylogenetic affinities to the other orders of Anthozoa. As already stated, the HERTWIGS had concluded on anatomical grounds that new mesenteries appeared in couples in a single mesenterial chamber, namely, that which lies opposite the single large siphonoglyph, and VON KOCH (1880) arrived at the same conclusion from observations made upon young larvæ of *C. membranaceus*. The evidence brought forward by VOGT (1880) and H. V. WILSON (1888) served to confirm the HERTWIGS' conclusions, and the matter was finally settled by the observations of BOVERI (1889) and myself on Arachnactis [1]).

At least it was settled so far as the development of all couples beyond and including

1) For a discussion of the systematic position of *A. brachiolata* see later, under the genus Arachnactis.

the fifth was concerned, but in the youngest individual observed by BOVERI the first four couples were already formed. I was fortunate enough to obtain a still younger larva of *A. brachiolata* in which but six mesenteries were formed, and by a comparison of this with older forms it was possible to determine, with a close approximation to certainty, the order of succession of the first four couples, and this proved to be identical with that which earlier observations had shown to occur in the Hexactinians, and quite different from that of the later formed couples.

It appears, then, that there can be recognized in the Ceriantharia two sets of mesenteries, one the protocnemes, consisting of the first four couples, in which the order of succession is similar to that occurring in the majority of Hexactinians, and a second, the deuterocnemes, consisting of all the remaining mesenteries, which appear successively in couples in the dorsal intermesenterial chamber. This distinction was clearly recognized by both BOVERI and myself, and was represented by diagrams in our respective papers. As this matter is of some importance in connection with the proper understanding of adult Ceriantharia I venture to append a diagram illustrating the arrangement and order of succession of the two sets (Text-figure I), the protocnemes being represented in red and designated by roman numerals, while the second set, the deuterocnemes, are represented in black and designated by arabic numerals.

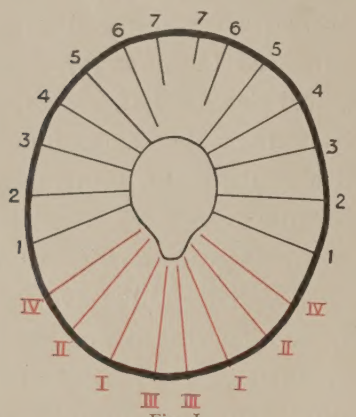

Fig. I.
Diagram showing the probable succession of the mesenteries in the Ceriantharia.
I + IV, protocnemes;
1—7, deuterocnemes.

From this diagram it will be seen that the order of succession of the protocnemes, starting from the midventral line, is III—I—II—IV, and the first couple of deuterocnemes makes its appearence in the intermesenterial chamber bounded by the two protocnemes belonging to the fourth couple. Comparing this sequence with that indicated by BOVERI in his figures, a discrepancy is observable in that those protocnemic couples which I have regarded as being the third and fourth are taken by BOVERI to be the fourth and third respectively; at least they are designated in his figures by *d* and *c*. The discrepancy, however, is an unimportant one, since BOVERI had no opportunity for determining the actual sequence of these mesenteries, nor, indeed, does he discuss their probable sequence. His designation of them may be regarded as a matter of convenience rather than as indication of their possible order of appearance.

The sequence which I have found for the protocnemes is of great importance, for it is identical with that characteristic of the majority of the Hexactiniæ and, in all probability, with that of the Zoantheæ; and it points back to an ancestral stage with eight mesenteries, common to all these groups, and from which the Ceriantheæ have branched off in one direction and the Hexactiniæ and Zoantheæ in another, as I have already maintained in previous papers. It is this ancestral character which gives to the protocnemes their great importance and which makes the recognition of protocnemes and deuterocnemes fundamental for the proper understanding of the adult Actiniaria.

Two authors, VAN BENEDEN and VANHÖFFEN, however, reached conclusions regarding the sequence of the protocnemes of Arachnactis more or less at variance with that described

above. VANHÖFFEN's observations (1895) were made, however, upon advanced larvæ, and his conclusions were based on the relative lengths of the different mesenteries in these. Little importance can therefore be assigned to them, for the principle upon which they are based is manifestly erroneous. VAN BENEDEN (1891), however, followed the development of the mesenteries in larvæ of different ages, and, while arriving at conclusions regarding their embryonic sequence identical with my own, denied that the protocnemes can be regarded as homologous with those of the Hexactiniæ. In proof of this position he makes a comparison between the first six couples of mesenteries in the two groups, and, designating them in their order, from the ventral directives dorsally, I—II—III—IV—V + VI, points out that the order of development in the Actiniaceæ is III—V—I—VI—II—IV, while in the Ceriantheæ it is II—III—I—IV—V—VI. I have already (1893) pointed out the fallacy of such a comparison. It proves nothing to the point, since it is a comparison between the protocnemes plus two couples of deuterocnemes in each group, and it is the very basis of the view propounded by BOVERI and myself that the two groups are primarily distinguished by the mode of appearance of the deuterocnemes. If these be omitted and comparison be made between the protocnemes alone then the sequence is the same in both groups, namely, III—I—II—IV. VAN BENEDEN, indeed, acknowledges this identity of succession for the protocnemes, but still maintains that those of the Ceriantharia cannot be regarded as identical with the so-called "Edwardsia mesenteries" of the Actiniaceæ, since they do not possess the adductor muscles so well developed in those mesenteries, and the Ceriantharia furthermore possess a well developed ectodermal musculature which is lacking in the Actiniaceæ. Surely these two points must be regarded as of little moment compared with the order of sequence of the mesenteries, and it must be remembered that BOVERI found indications of adductor muscles, identical in their arrangement with those on the Hexactinian protocnemes, in the Cerianthid larvæ he studied. As to the ectodermal musculature being an important characteristic it is only necessary to refer to the rapidly increasing number of Actiniaceæ in which it has been found, our present information on the subject seeming to indicate that it must be regarded as a primitive Anthozoan character, which has been lost in the majority of the Actiniaceæ and retained in the Ceriantharia.

In his later paper (1898), rich in so many important discoveries, VAN BENEDEN adheres to the position taken seven years before and, while recognizing the existence of two distinct phases of development in both the Actiniaceæ and the Ceriantharia, declines to regard the first stage as identical in the two groups. In the Actiniaceæ he regards the first stage as terminating with the formation of the sixth couple of mesenteries, while that of the Ceriantharia terminates with the formation of the third couple; and for this first stage of the Actiniaceæ he suggests the name *Halcampula*, while for that of the Ceriantheæ he employs the name *Cerinula*. In making this delimitation of stages it is to be noted that the criterion chosen is quite different in the two groups. In the Actiniaceæ it is the cessation of the appearance of the mesenteries in couples, while in the Ceriantharia it is an alteration in the order of sequence of the couples.

With the typical sequence of the Hexactinian protocnemes, under which term I would include only the first four couples, so well determined, it is a little difficult to understand why

VAN BENEDEN should draw the line which separates his Cerinula stage from the second phase of development immediately at the close of the formation of the third couple of mesenteries. A clue is probably to be found in his observation that all mesenteries in the Ceriantharia make their appearance dorsal to the first couple, with the exception of the third couple. This interrupts the symmetrical order of the succession, which, after the appearance of the third couple is again resumed, and it is the resumption of the symmetrical succession that marks the beginning of the second phase of development. The interruption, however, seems to be of less importance than such a view would give it, and further, it may be noted that the same symmetrical succession and interruption may be recognized in the development of the protocnemes of the Hexactiniæ, but since the deuterocnemes do not form successively in the dorsal intermesenterial chamber it is not so striking as in the Ceriantharia. The mere fact that there is an interruption to the continued symmetry of succession militates against its acceptance as a criterion, and the facts that the same sequence exists for the first four Cerianthan couples as for the same Hexactinian couples and that an entirely different order of sequence supervenes with the fifth couple in the two groups seem to point strongly to the recognition of the identity of the first four couples in both groups.

I have in earlier papers taken the position that not two but three stages of development are to be recognized in the Hexactiniæ; (1) a protocnemic stage in which four couples of mesenteries are formed, (2) a deuterocnemic stage in which two additional couples appear, one in each of the lateral interspaces and (3) a zygocnemic stage in which the mesenteries appear in pairs. The first stage I believe to be common to all the Anthozoa, and to be the only stage represented in the Alcyonaria, the deuterocneme stage occurs in the Ceriantharia, Zoantheæ and Actiniaceæ, but while it is identical in the Zoantheæ and Actiniaceæ it is different in the Ceriantheæ, that group separating from the other two at the conclusion of the first stage. Finally, the zygocneme stage occurs in the Zoantheæ and Actiniaceæ, but differs in the two groups, which separated at its appearance. DUERDEN's observations indicate that the Rugosa also possessed three stages, the third again differing from that of the Zoantheæ and Actiniaceæ, and from VAN BENEDEN's own observations (1898) it would seem that only two stages are represented in the Antipatharia and that these stages are possibly identical with the corresponding stages of the Actiniaceæ and Zoantheæ. This last point can only be settled, however, by a determination of the order of sequence of the Antipatharian mesenteries.

I have discussed this question of the homology of the Cerianthan protocnemes at some length, because it has an important bearing upon the significance of certain structural peculiarities which I have noted in the forms represented in the "Siboga" collection. These peculiarities do not in themselves involve the identity of the protocnemes of the Ceriantharia with those of the Hexactiniæ, but they do point strongly toward a necessity for a recognition of four couples of protocnemes in the former group. In considering these peculiarities it will be well to review briefly our knowledge of the arrangement of the mesenteries in the Ceriantharia, but before doing so it is necessary to consider the terms of orientation that are to be used.

It has been a general custom to speak of the two extremities of an Anthozoan as oral and aboral, or else as distal and proximal, and to regard the edges of the plane which passes

through the directive endocoels as representing the dorsal and ventral lines. Furthermore, in cases in which but a single siphonoglyph occurred it has been customary to regard it as occupying a ventral position. On this basis the surface of a Cerianthid occupied by the protocnemes would be the ventral one, while that at which the formation of new deuterocnemes occurs would be designated as dorsal.

Objections have been raised against this terminology inasmuch as it implies an arbitrary homology of the surface at which the single siphonoglyph occurs throughout the entire group of the Anthozoa, and CARLGREN (1893), from his observations on the arrangement of the musculature in the mesenteries of adult Cerianthids, has maintained that in reality the siphonoglyph (sulcular) surface in these forms is probably equivalent to the sulcular surface of the Alcyonaria, for instance, and if we term this dorsal, then the protocnemes of the Cerianthids are dorsal and the deuterocnemes form in the ventral chamber.

In opposition to CARLGREN's observations stands BOVERI's account of the arrangement of the musculature in Arachnactis, which shows an orientation of the longitudinal muscle fibres of the protocnemes with reference to the siphonoglyph identical with that occurring in such monoglyphic forms as the Zoantheæ and Oractis, assuming, as I believe there is every reason for doing, that the sequence which I have assigned (1891) to the protocnemes of these forms is correct. But apart from this and disregarding entirely the evidence derivable from the arrangement of the musculature, there is the more pertinent evidence derived from the homology of the mesenteries as determined by their sequence. If this be accepted as a criterion, and the sequence of the Cerianthid mesenteries be as I have maintained, it follows that if we regard the single siphonoglyph of the Zoanthids as ventral we must apply the same designation to that of the Cerianthids. In what follows, accordingly, I shall employ that orientation and speak of that surface of the Cerianthеæ which is occupied by the protocnemes as ventral and of that occupied by the deuterocnemes as dorsal [1]).

The Arrangement of the Mesenteries. The first definite information which we possess concerning the arrangement of the mesenteries of the Cerianthеæ was furnished by HAIME (1854), who observed that in *C. membranaceus* the mesenteries were not paired and were alternately longer and shorter; further, he also noted the occurrence of a couple which extended the entire length of the body and bounded a groove which he termed "la gouttière interlamellaire impaire". VON HEIDER (1879) made an important addition to HAIME's observations by discovering that short sterile mesenteries regularly alternated with the fertile ones, which were the only ones that HAIME had observed, and he further noted the existemce of a couple of short sterile mesenteries, those which we now call the directives, lying between the long ones which bounded the gouttière impaire. As a result of these observations he recognized three grades of mesenteries as occurring in Cerianthus, namely, (1) short sterile mesenteries which he called Filamentsepta, (2) the longer fertile mesenteries which he termed Genitalsepta, and (3) the long couple bounding the gouttière impaire which he termed the "continuirliche

1) I do not propose to discuss the use of the terms anterior and posterior suggested by VAN BENEDEN as indicating more correctly the relationship of the Cerianthеæ to the metameric animals. The theory upon which the application of these terms rests seems to me too insecure to warrant so radical a change in our ideas of the tectology of the Anthozoa.

Septa". O. and R. HERTWIG (1879) published an account of the arrangement of the mesenteries which did not differ materially from that of HAIME, but in a postcript, written after the appearance of VON HEIDER's paper, they added a confirmation of his results.

All these observations were made on *C. membranaceus*, for although the HERTWIGS mention *C. solitarius* as having been included within the scope of their observations, it would seem that their anatomical studies were confined to the first named species. In 1890 I showed that in *C. americanus*, while the general plan of the mesenteries was essentially the same as in *C. membranaceus*, there were differences in the details. Thus I noted, as HAIME had done, that shorter fertile mesenteries alternated with longer ones, and also that short sterile mesenteries alternated with both series of fertile ones. The short directives and the continuous septa were also observed, but these latter were not the only mesenteries which reached the aboral pole of the body, several of the longer fertile ones having a similar length.

In 1891 FAUROT, from his studies on *C. membranaceus*, brought into prominence an important characteristic in the arrangement of the mesenteries of that form, namely, that as a result of the alternation of sterile and fertile mesenteries and of the alternation of short and long fertile ones, there was in reality an arrangement of the deuterocnemes, at least, in quartettes or as FAUROT preferred to term them quatrosepta. The mesenteries in the vicinity of the siphonoglyph were found to present an arrangement different from that of the more lateral quartettes, and while at first Faurot regarded the four mesenteries on either side of the mid-ventral line as representing an aberrant quartette, in his later paper (1895) he places only the three ventral couples in a group apart and begins the enumeration of the quartettes with the fourth couple. In making this change, which cannot be regarded as a happy one, FAUROT was apparently influenced by the views of VAN BENEDEN (1891) concerning the significance of the Cerianthid protocnemes, and the latter author in his account of the arrangement of the mesenteries in *C. lloydii* (1898) also regards the fourth couple from the mid-ventral line as the beginning of the first quartette.

I have given above what seem to me to be good reasons for regarding the fourth couple as belonging to the same series as the more ventral couples; for regarding, in other words, the four ventral couples as forming a protocnemic group, and all the other couples as forming a deuterocnemic group, and on this ground alone it seems to me preferable to regard the quartettes as beginning with the fifth couple of mesenteries, that is to say, with the first deuterocneme. The quartette arrangement, under such a system of enumeration, would be characteristic of the deuterocnemes, leaving the protocnemes as a group apart.

The Protocnemic Mesenteries. The four couples of mesenteries which represent the protocnemes in the adult have a very similar arrangement in those species in which the arrangement has been longest known, as, for example, in *C. membranaceus* (Haime, 1854; von Heider, 1879; Faurot, 1895), *C. lloydii* (van Beneden, 1898) *C. verrillii* (Kingsley, 1904) [1])

1) I propose this name for the species described by VERRILL (1873) as *C. borealis* sp. nov. for the reason that the term that VERRILL applied to it had already been employed by DANIELSSEN (1860) for another species. KINGSLEY in his paper on VERRILL's *C. borealis* (1904) discusses the synonomy of the two species but he assigns the use of the specific name by DANIELSSEN to 1885, and on that account retains *borealis* for VERRILL's species and proposes to term DANIELSSEN's *C. danielsseni*. He has, however, overlooked the

and *C. americanus* (Mc Murrich, 1890). Within recent years, however, a number of forms that show a distinctly different arrangement of these mesenteries have been described, such as *Pachycerianthus benedeni* (Roule, 1904), *P. oligopodus* (Cerfontaine, 1909) and *P. æstuari*, *P. johnsoni* and *Botryanthus benedeni* (Torrey and Kleeberger, 1909)[1]. Since the publication of von Heider's paper (1879) it has been recognized that the most ventral couple of mesenteries of *C. membranaceus* is characterized by being short, sterile and destitute of mesenterial filaments, and that the second couple extends to the aboral pole, is fertile and is provided with mesenterial filaments. The same conditions obtain for the corresponding mesenteries of the other three species of Cerianthus mentioned above, and to the most ventral couple the term directives has been applied, while the second couple of mesenteries have been termed the continuous mesenteries, a term which may be conveniently replaced by *telocnemes*. The third couple resemble the directives in being sterile, except, apparently, in *C. verrillii*, but they are provided with mesenterial filaments, much coiled in a portion of their course (data with regard to this point being lacking for *C. verrillii*); their length varies in the different species, but they are always considerably shorter than the mesenteries on either side of them. The fourth couple resembles the telocnemes in being fertile and provided with mesenterial filaments, which, however, do not show the extensive coiling presented by those of the third couple; considerable variation in length is shown by these mesenteries in different species, since in *C. lloydii* and *C. verrillii* they are almost as long as the telocnemes, while in *C. membranaceus* and *C. americanus* they are much shorter, in the former species, however, being longer than any of the deuterocnemes, while in the latter they are surpassed by a number of them.

In these four species, therefore, there is a general uniformity in the character of the protocnemes, which may be expressed in a few words by saying that the telocnemes are the second couple. In 1904, however, Roule described an arrangement of the mesenteries in a form which he named *Pachycerianthus benedeni*, which differs markedly from that just described in that it is the fourth couple instead of the second which become the telocnemes. He finds that the mesenteries are nearly all rather short, extending but a short distance beyond the lower edge of the stomatodaeum, but two of them, which, using van Beneden's nomenclature (1898), he designates S^3 reach the aboral pole, enclosing the gouttière impaire, which contains vestiges of the mesenteries D and S^1, these being the first and second protocnemic couples. No mention is made in his paper of the third couple of protocnemes, but it is evident that they too must lie in the gouttière impaire. Such an arrangement is exceedingly interesting and important, and it was of no little interest to find in the "Siboga" collection two species which also showed it. One of these seems to be identical with the form described by Kwietniewski (1898) as *C.*

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fact that Danielssen first employed the name in 1860 and that it was given as a synonym of *C. lloydii* by Sars in 1861. Danielssen's application of the term certainly has the priority and it is Verrill's use of it that must be given up. It is interesting to note that the term *C. danielsseni* which Kingsley proposed for *C. borealis* Dan., was also suggested for that form by Levinsen in 1893, and that the same name has also been bestowed by Roule upon a species described by him in 1905.

1) These last three species the authors refer to the genus Cerianthus. The arrangement of the protocnemes shows that two of them must be referred to the same genus as the *Pachycerianthus benedeni* of Roule (1904). As to the third if we accept the validity of van Beneden's division of the Cerianthidæ into the two groups Acontiferæ and Botrucnidiferæ, it must be referred to the latter group and therefore must be separated from Cerianthus. I suggest for it the name Botryanthus, unless it be shown in the future to belong to one of the genera van Beneden has established for Botrucnidiferous larvæ.

elongatus, and I shall refer to it in what follows as *Pachycerianthus fimbriatus* [1]), while the other may be termed *P. monostichus*, the specific term referring to the arrangement of the labial tentacles which will be described later. The same arrangement is also described by CERFONTAINE (1909) as occuring in *P. oligopodus*.

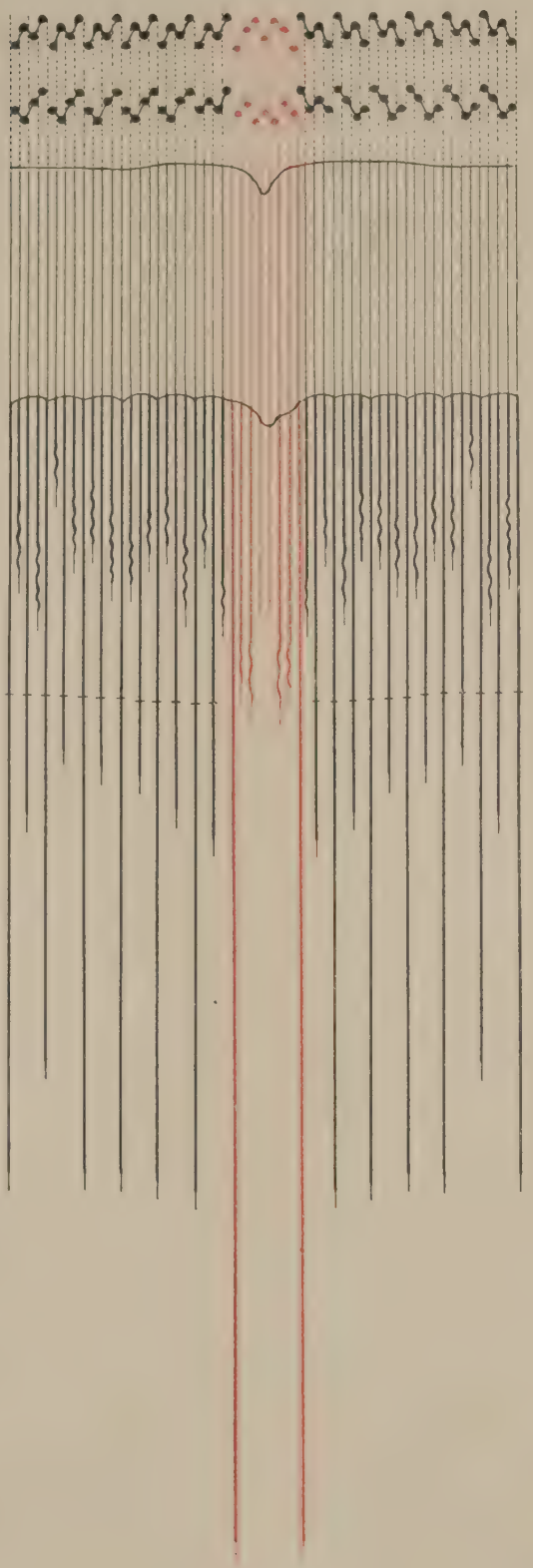


Fig. II. Diagram showing the arrangement of the mesenteries in *Pachycerianthus fimbriatus*. The protocnemes are represented in red.

In *P. fimbriatus*, two individuals of which proved to be in a most admirable condition for investigation, the arrangement of the protocnemes was as follows [2]). The directive mesenteries, like those of other species, were short, sterile and destitute of mesenterial filaments. The second and third couples were but little longer than the sterile mesenteries of the deuterocnemic quartettes (see Text-figure II), which they resembled in being provided with mesenterial filaments extensively coiled in the lower part of their course. Following VON HEIDER's classification both couples of mesenteries would be referred to the group of Filamentsepta, and the only appreciable difference in the two was that the mesenteries of the second couple were slightly longer than those of the third. The fourth couple on the other hand, was formed by two mesenteries which were fertile and provided with mesenterial filaments that were not extensively coiled, and they alone of all the mesenteries, both protocnemes and deuterocnemes, reached the aboral pole. They have, then, all the characters of telocnemes, but they differ from those of *C. membranaceus*, etc. in being the fourth couple of protocnemes instead of the second.

1) The specific name given by KWIETNIEWSKI is changed since it had already been employed by GRUBE (1840) for a form which he named *Actinia elongata*, but which was probably *Cerianthus membranaceus*.

2) The two individuals upon which this description is mainly based were preserved in formalin, and their condition was well nigh perfect. The other examples, of which there were quite a number, had been placed in alcohol and were all in a more or less macerated condition. It was possible, however, to determine in a number of these that the general arrangement of the mesenteries was identical with that of the formalin examples.

In *P. monostichus* (see Text-figure X), in *P. oligopodus* and in *P. æstuari*, *P. Johnsoni* and *Botryanthus benedeni* the arrangement is essentially the same. On either side of the short, sterile directives are two sterile mesenteries, both of which are considerably longer than the directives, though but little longer than the sterile deuterocnemes, those of the second couple being longer than those of the third. The fourth couple of protocnemes consists of fertile mesenteries which reach the aboral pole.

In four distinct species, then, the telocnemes are the fourth couple counting from the mid-ventral line, and this arrangement seems therefore to have more than mere specific value. If so, the question arises as to whether indications of the two arrangements can be found in the early stages of development. A study of the various larval forms described so thoroughly by VAN BENEDEN (1898), together with my own observations on some additional ones obtained by the "Siboga", have led to some interesting results in this connection.

VAN BENEDEN has divided the larvæ he studied into two groups characterized by the appendages which occur on certain of the longer mesenteries. In one group these mesenteries bear peculiar aggregations of cells which may be set free within the coelenteron and have been termed *botrucnidæ*, while in the other group the appendage is a more or less filamentous structure which van Beneden has identified as an acontium. The Botrucnidiferæ need not concern us here; but in the Acontiferæ will be found certain variations in the mesenteries which bear the acontia, and in correlation with these apparently certain other peculiarities of structure. Unfortunately the acontia are in some cases a little late in making their appearance, and some of the larvæ obtained do not possess them, but in several of such cases one or more of the other peculiarities are evident and from these it may be predicted upon what mesenteries the acontia will appear.

To consider first the acontia. These occur as a rule only on one or two couples of mesenteries, the more ventral of which may be either the second or the fourth protocneme. In *Arachnactis albida*, in his three species of Ovactis and in *Dactylactis armata* and *D. digitata* VAN BENEDEN found the acontia upon the fourth couple and they are also clearly shown on the fourth couple in BOVERI's fig. 3 (1890) although he did not perceive their significance; GRAVIER (1904), found them on the fourth and sixth couples in *D. benedeni*; and to this list I can add *Ovactis wilsoni* and from the "Siboga" material *Arachnactis siboga* and *Dactylactis malayensis*, all three with the acontia on the fourth couple, so that it would seem fairly certain that in these three genera, Dactylactis, Arachnactis and Ovactis, the acontia are borne by the fourth protocnemes. In the species of the three remaining genera described by VAN BENEDEN the acontia had not appeared in the larvae studied, but in the "Siboga" collection I find representatives of two of these genera, namely Apiactis and Peponactis, and in the species belonging to the former the acontia are borne by the second protocnemes and in the species of Peponactis they are present on both the second and fourth protocnemes.

In the more advanced larvæ of the first group it is found that in addition to the fourth couple being the first to possess acontia, the are also the longest of the protocnemes. This is the case in *Arachnactis albida*, *A. sibogæ*, *Ovactis brasiliensis*, *O. æquatorialis*, *O. wilsoni*, *Dactylactis armata*, *D. digitata*, *D. benedeni* and *D. sibogæ*. Of the other known species of

these genera it is true that in the oldest stages yet observed the fourth couple is shorter than the second, but this may justifiably be regarded as due to the known stages being too young to show the definite length relations of the mesenteries. The fourth couple is formed later than the second and must for a time therefore, be shorter than the second in all species, and it may be supposed that its shortness in the forms under consideration is a condition which will later be corrected. In *Ovactis bermudensis* we certainly cannot consider the arrangement seen in the oldest know larva as necessarily representing the adult relations, and this is equally true for *Dactylactis inermis* and *D. elegans* and perhaps also for *Solasteractis macropoda* in regard to which there is yet no information as to the development of the acontia. It is true that in the oldest known example of *Ovactis brasiliensis* described by VAN BENEDEN the second couple is still longer than the fourth, but in the monstrous form of the same species it is noticeable that on one side of the sagittal plane the mesentery of the fourth couple is the longer, and this being the relative length of the couple in other species of the genus, it may be regarded as indicating what the adult relations will be.

There are, then, in the protocnemes of quite an extensive series of forms two associated peculiarities which seem to be constant, and are therefore to be regarded as characters of taxonomic importance. But before taking up this question further I wish to consider the arrangement of the deuterocnemes and certain other structural features of the order.

The Deuterocnemic Mesenteries. The development of our knowledge of the arrangement of the deuterocnemic mesenteries has already been described and the important discovery of FAUROT (1891) of the quartette arrangement has been noted. It has also been pointed out that FAUROT in his later paper (1895) and VAN BENEDEN (1898) begin the enumeration of the quartettes with the last protocnemes, a method which is inconsistent with the true relationship of the two sets of mesenteries. Correcting this error, in each of the species hitherto described in which the quartettes have been sufficiently studied each is composed of two sterile and two fertile mesenteries, the sterile and the fertile alternating. In the different species considerable differences occur in the relative lengths of the mesenteries composing each quartette, and it seems probable that these differences may have a classificatory value, although this cannot be definitely determined until a greater number of individuals of each species has been studied.

Before calling attention to these differences a few words are necessary as to the nomenclature of the quartette mesenteries. VON HEIDER's terms Filamentsepta and Genitalsepta are not quite opposite for several reasons, the fact that in one of the species to be described later the Filamentsepta as well as the Genitalsepta bear reproductive organs being the most important one, and the same fact makes the use of the terms sterile and fertile also inappropriate. In what follows I shall term the longer mesenteries (VON HEIDER's Genitalsepta) *macrocnemes* and the shorter ones (VON HEIDER's Filamentsepta) *brachycnemes*.

In *C. membranaceus* the first quartette, that is to say that nearest the protocnemic group, consists of first a brachycneme, to which succeeds a macrocneme, then a second brachycneme somewhat shorter than the first and then a second macrocneme longer than the first one (See Text-figure III). If the brachycnemes be represented by *b* and *B* for the shorter and longer mesenteries respectively and the macrocnemes be similarly represented by *m* and *M*, the

arrangement of the quartette may be represented by the formula *B—m—b—M*. The same formula answers also for the succeeding quartettes, but it will be observed that in each quartette there is a gradual diminution in the length of each of the four kinds of mesenteries compared with the corresponding mesentery of the preceeding quartette. In other words the mesenteries of each kind diminish gradually in length towards the dorsal mid-line, the length of any one kind being proportional to that of the preceeding quartette. Hence, as regards their lengths four different kinds of deuterocnemes may be recognized. Along with this arrangement is to be noted the fact that none of the deuterocnemes approach the aboral pole.

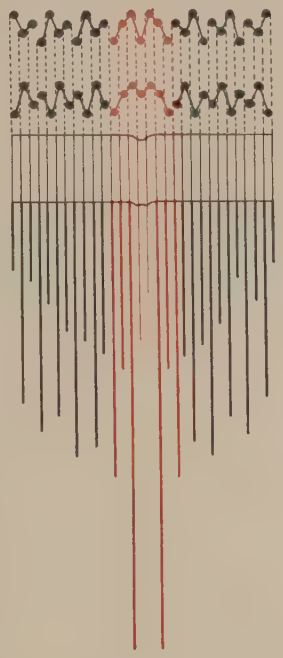


Fig. III.
Diagram showing the arrangement of the mesenteries of *Cerianthus membranaceus*. Adapted from FAUROT.

In *C. verrillii* the arrangement of the mesenteries in the quartettes is essentially the same as in *C. membranaceus*, being expressed by the formula *B—m—b—M*, and the same correlation in length of the individual mesenteries of each set also occurs. A differance is found, however, in the fact that three of the longer macrocnemes on each side extend almost to the aboral pole and there is a gradual diminution of the remainder of this set towards the dorsal mid-line (See KINGSLEY, 1904).

In *P. fimbriatus* (See Text-figure II, p. 12) the arrangement is similar to that of *C. membranaceus*, although in the single example carefully examined the regular diminution in length of the various kinds of mesenteries was interrupted in the third, fourth, fifth and sixth quartettes, but resumed in the succeeding ones. None of the deuterocnemes approach the aboral pole.

In *P. monostichus*, so far as I was able to ascertain the arrangement, it was similar to that of *C. verrillii*, but an account of the details of the arrangement both in this form and in the preceeding one will be given later with the description of the species (See Text-figure X).

In these four species, then, the arrangement of the quartettes was according to the formula *B—m—b—M*. In the two species now to be mentioned we find a different formula is necessary, namely, *B—M—b—m*; that is to say, the longer macrocneme precedes the shorter one in each quartette. This is the case in *C. lloydii* (Van Beneden, 1898), and in this form we find that while the two sets of brachycnemes have an independently progressing length-diminution towards the dorsal surface, the two sets of macrocnemes form one diminishing series, the shorter macrocneme of the first quartette being longer than the longer one of the second quartette and so on. Furthermore, the macrocnemes of the first two quartettes extend to the neighbourhood of the aboral pole, but with the third quartette a sudden diminution in length comes in, none of the mesenteries from this one extending beyond the middle of the column.

In *C. americanus* (Mc Murrich, 1890; see also Text-figure IV) the quartette arrangement is also *B—M—b—m*. The brachycnemes are all very short, extending but a short distance below the lower border of the stomatodæum, so that the amount of difference in length of those of each quartette is relatively small though appreciable, and, as a rule, the longer one

was that nearer the ventral line. Similarly, owing to the shortness of these mesenteries their gradual diminution in successive quartettes was not very pronounced.

As regards the macrocnemes, there is a great disparity in the lengths of the shorter and longer ones, the former extending but a short distance below the lower border of the stomatodæum, while the latter reach at least as far as the middle of the column, some of them almost to the aboral pole. Nor is the ventro-dorsal diminution of the longer macrocnemes a constant one. In four individuals examined the longer macrocneme of the first quartette reached a little beyond the middle of the column, that of the second quartette almost to the aboral pole, that of the third to about the lower fifth of the column, and that of the fourth almost to the aboral pole. Beyond this some variation occurred, the long mesenteries of the fifth and sixth quartettes reaching to beyond the middle of the column, that of the sixth being usually, but not always, slightly the longer of the two, and then followed sometimes one, and sometimes two quartettes in which the mesenteries under consideration almost reached the aboral pole, and in the remaining three or four quartettes they rapidly diminished in length.

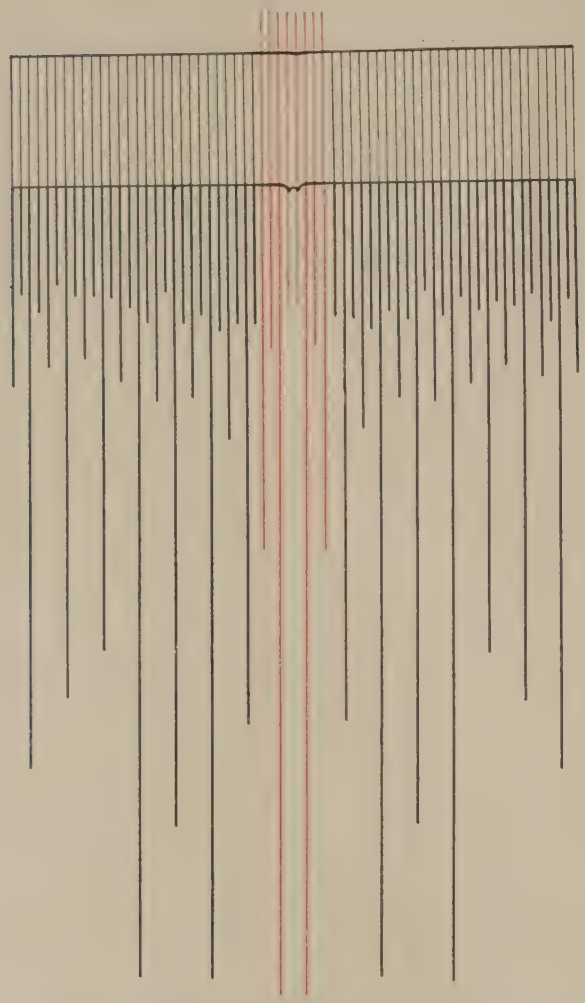


Fig. IV.
Diagram showing the arrangement of the mesenteries of *Cerianthus americanus*.

In all the forms hitherto described the alternation of sterile and fertile mesenteries is characteristic of the quartettes, but in a form found in the "Siboga" collection and which I identify with *C. ambonensis* this was not the case, all the mesenteries, both protocnemes and deuterocnemes, being fertile with the exception of the directive couple. A detailed account of this form will be given later on and it need merely be stated here that the deuterocnemes were arranged in two alternating sets, the brachycnemes extending only to about 3 cm. below the lower border of the stomatodæum, while the macrocnemes were continued onwards for another 3 cm., reaching to within 2 cm., of the aboral pole, the telocnemes, which are the protrocnemes, being the only mesenteries to reach that pole. Whether slight variations in length of the macrocnemes of each, or even of successive quartettes, were always present I was unable to determine, the arrangement of the deuterocnemes appearing to be in duettes rather than in quartettes (See Text-figure V, p. 28).

The Arrangement of the Tentacles. Since FISCHER discovered (1889) in *C. membranaceus* the existence of an unpaired tentacle corresponding to the ventral siphonoglyph, various attempts have been made to formulate a definite arrangement for the marginal and labial tentacles. Although in their details these attempts have produced somewhat discordant results, yet they have shown that the tentacles of the Cerianthids cannot be regarded as being arranged in cycles comparable to those of the Actiniaceæ; that, however, cycles of another type can be made out; that the corresponding tentacles of the marginal and labial sets do not necessarily belong to corresponding cycles; and that the tentacles of the various quartette groups are, in general, definitely and similarly arranged with regard to the cycles.

One of the discrepancies noticeable in the different observations is the number of cycles recognized. Thus, FISCHER (1889) recognizes but three, while CERFONTAINE (1891), FAUROT (1895) and CARLGREN (1900) admit four in each set, and VAN BENEDEN (1898) recognizes in *C. lloydii* three in the marginal and four in the labial set. The difference is, however, of comparatively little importance, since the two outer cycles are somewhat crowded together and differences of contraction will readily lead to confusion of the two. In the examples of *P. fimbriatus* which I have studied there are four cycles in each set, but here and there, at different portions of the circumference, it is difficult to determine whether a tentacle belongs to the third or the fourth cycle, especially in the case of the marginal set.

The differences observed in the arrangement of the tentacles in the various cycles are of greater importance. The arrangement which FAUROT (1895) figures for the marginal tentacles of *C. membranaceus* may be represented thus:

— 1 | 4, 2, 3, 1 | 4, 2, 3, 1 ‖ 3, 4, 1, 4, 3 ‖ 1, 3, 2, 4 | 1, 3, 2, 4 | 1 —,

a formula which represents the protocnemic tentacles and two quartettes on either side, and which may better be represented thus; recognizing the fourth tentacle from the mid-ventral line as belonging to the protocnemic set;

— 1, 4, 2, 3 | 1, 4, 2, 3 ‖ 1, 3, 4, 1, 4, 3, 1 ‖ 3, 2, 4, 1 | 3, 2, 4, 1 —.

Earlier, however, CERFONTAINE (1891) had found the arrangement to be as follows:

— 1, 3, 2, 4 | 1, 3, 2, 4 ‖ 1, 3, 4, 2, 4, 3, 1 ‖ 4, 2, 3, 1 | 4, 2, 3, 1 —,

the difference arising from a confusion of the third and fourth cycles in the quartette tentacles and of the first and second in the protocnemic ones. CARLGREN (1900) confirmed CERFONTAINE's results and found the same arrangement in *C. lloydii*, in which form VAN BENEDEN (1898) had described the arrangement as

— 3, 2, 3, 1 | 3, 2, 3, 1 ‖ 2, 3, 2, 3, 2 ‖ 1, 3, 2, 3 | 1, 3, 2, 3 —

which may be better expressed thus:

— 1, 3, 2, 3 | 1, 3, 2, 3 ‖ 1, 2, 3, 2, 3, 2, 1 ‖ 3, 2, 3, 1 | 3, 2, 3, 1 —.

The difference is explicable, so far as the quartette tentacles are concerned by the fact that VAN BENEDEN recognized only three cycles in the marginal set of tentacles; there is, however, a discrepancy in the arrangement of the protocnemic tentacles. In *C. solitarius* Carlgren found the same arrangement as in the other forms, although the third and fourth cycles are less clearly distinguishable and irregularities, due to the failure of tentacles to develope, occur.

As regards the labial tentacles, FAUROT finds in *C. membranaceus* an arrangement which may be expressed thus:

— 2, 1, 3, 4 | 2, 1, 2, 1 | 2, 1, 4, 2 ‖ 1, 3, 4, 3, 4, 3, 1 ‖ 2, 4, 1, 2 | 1, 2, 1, 2 | 4, 3, 1, 2 —

while CARLGREN finds

— 2, 1, 3, 4 | 2, 3, 2, 4 ‖ 3, 1, 3, 2, 3, 1, 3 ‖ 4, 2, 3, 2 | 4, 3, 1, 2 —.

VAN BENEDEN gives an arrangement for *C. lloydii* which may be expressed by

— 2, 1, 3, 4 | 2, 3, 1, 4 ‖ 4, 2, 3, 0, 3, 2, 4 ‖ 4, 1, 3, 2 | 4, 3, 1, 2 —,

while CARLGREN finds in the same species

— 2, 1, 3, 4 | 2, 3, 2, 4 ‖ 3, 2, 4, 0, 4, 2, 3 ‖ 4, 2, 3, 2 | 4, 3, 1, 2 —.

In *C. solitarius* Carlgren finds the same arrangement as in *C. membranaceus*.

In looking over these results it seems clear that there is a general similarity and the differences are probably largely due to the difficulty of correctly following the lines of the various cycles and avoiding the danger of being deceived by differences of contraction.

In *P. fimbriatus* the arrangement I found to be

— 1, 3, 2, 4 | 1, 3, 2, 4 ‖ 1, 3, 4, 2, 4, 3, 1 ‖ 4, 2, 3, 1 | 4, 2, 3, 1 —,

although it must be said that a distinction between thc fourth and third cycles was not always discernible. For the labial tentacles I obtained the formula

— 2, 1, 3, 4 | 2, 3, 2, 4 ‖ 2, 1, 3, 2, 3, 1, 2 ‖ 4, 2, 3, 2 | 4, 3, 1, 2 —.

The arrangement of the marginal tentacles is, therefore, identical with what CARLGREN found in *C. membranaceus*, *C. lloydii* and *C. solitarius*, but I find a difference in the arrangement of the labial tentacles, a difference which may, however be due rather to the difficulties of the determination and to the small number of examples (2) suitable for examination.

In other forms, however, decided departures from this arrangement occur. Thus in *C. taeda* the marginal tentacles seem to be arranged in only two cycles, their formula being

— 2, 1, 2, 1 | 2, 1, 2, 1 ‖ 2, 1, 2, 1, 2, 1, 2 ‖ 1, 2, 1, 2 | 1, 2, 1, 2 —,

while the labials are on a quadricyclic plan, their formula being

— 1, 2, 4, 3 | 1, 2, 4, 3 ‖ 1, 3, 4, 2, 4, 3, 1 ‖ 3, 4, 2, 1 | 3, 4, 2, 1 —.

In *C. monostichus* the marginal tentacles, so far as could be determined, seemed to have the same formula as *C. taedus*, but, on the other hand, the labials were in a single row.

In no larval forms has an arrangement of the tentacles in multiple cycles been observed, all, both marginal and labial, lying in a single cycle. The multicyclical arrangement of the adult may be due to merely mechanical causes, as was suggested by VON HEIDER. This explanation, however, by itself hardly suffices for the regularity of the arrangement recurring in the various quartette groups, and the possibility of some additional factor imposed by the arrangement of the mesenteries suggests itself. From what is seen in larval forms it is evident that the formation of new mesenteries always precedes that of new tentacles, and, consequently, the tentacles corresponding to any mesentery is that communicating with the intermesenterial chamber next ventral to it. An examination of the marginal tentacles of the quartettes will show that the tentacles of the two proximal cycles are those corresponding to the macrocnemes, while those

of the two distal cycles correspond to the brachycnemes. The marginal tentacles corresponding to the protocnemes and the labials do not, however, present this relation, and its value as a determining factor must therefore remain uncertain.

The Mesenterial Filaments. The structure of the mesenterial filaments of the Ceriantheæ has been considered by VON HEIDER (1879), the HERTWIGS (1879) and VAN BENEDEN (1898). VON HEIDER noted the occurrence in *C. membranaceus* of a thickened border to the mesenteries, and observed, too, that the thickening extended to a much lower level upon the fertile mesenteries than upon the sterile ones, the edge of the mesentery below this thickening being occupied by a much smaller swelling. Furthermore he observed that toward its extremity the upper larger thickening on the sterile mesenteries became much contorted and gave off numerous branch filaments, which he identified with acontia. Similar branch filaments, though less numerous, were observed also on the fertile mesenteries and they were found to occur scattered along almost the entire length of the telocnemes.

The HERTWIGS added to VON HEIDER's description a much more accurate account of the finer structure of the filaments. They figure on Pl. VIII, fig. 12 of their paper the upper portion of a mesentery, showing the upper portion of the filament but slightly wavy and bearing numerous slender, branched processes, this portion being succeeded by a stretch in which the filament is greatly coiled. Below this the filament is described as running in a wavy course to the end of the mesentery. In its upper part the filament is shown to consist of three clearly differentiated portions, a median "Nesseldrüsenstreif" and two lateral "Flimmerstreifen", its structure, therefore being exactly comparable to that of the upper trefoil portion of the Actiniacean filament. The processes arising from the filament were shown, however, to be very different in structure from the Actiniacean acontia, being extremely attenuated folds of the filament, possessing "Flimmerstreifen" as well as "Nesseldrüsenstreifen" and of each of these an ascending as well as a descending limb.

VAN BENEDEN confirmed the HERTWIGS' observations as to the trefoil structure of the upper portion of the filament and also VON HEIDER's account of the greater extent of the trefoil in the fertile than in the sterile mesenteries; he noted too that the greatly coiled portion of the filament occurred only on the sterile mesenteries and that the filament in this portion of its course was no longer a trefoil, but simple. His most important addition to our knowledge of the filaments was the discovery of true acontia in larval forms, arising from the free edge of one or more of the fertile mesenteries, usually some distance below the termination of the mesenterial filament and resembling closely in their structure the acontia of the Actiniaceæ. This discovery completed the proof of the distinctness of the branching processes of the trefoil portion of the filaments and the acontia, and it consequently seems advisable that we should now have a term to distinguish the processes. The HERTWIGS, it is true, named them "Mesenterialfäden", but this term is a little too similar to mesenterial filament to prevent confusion, and it would seem both convenient and apposite to translate the term and to speak of the processes as craspedonemes.

Owing to the excellent preservation of some of the examples of *P. fimbriatus* in the present collection it has been possible to make a thorough study of the structure and arrange-

ment of the mesenterial filaments of that form, and a record of the results, combined with some observations on the filaments of *C. americanus*, seems advisable for the purpose of rounding out our present information concerning the mesenterial filaments of the Ceriantheæ.

In both the forms mentioned all the mesenteries, with the exception of the directives, are provided with mesenterial filaments, and all of these possess the same histological structure. As in the filaments of the Actiniaceæ, two portions are recognizable in each filament, an upper trilobed portion and a lower simpler portion, but in the Ceriantheæ marked differences in the extent of development of the two portions are shown by the macrocnemes and brachycnemes. In the latter the uppermost portion immediately succeeding the lower border of the stomatodæum has an almost straight free border, and throughout this stretch the filament is trilobed. This portion is succeeded by a stretch in which the border is much folded and apparently branched, and throughout which the filament is single-lobed (this portion is represented as wavy in text-figure II, p. 12); and below this again, the free edge is almost straight and the single-lobed portion of the filament is continued along it almost to its termination, only the terminal portion of the mesentery being destitute of a filament.

In the macrocnemes, on the other hand, the trilobed portion of the filament extends a much greater distance down the mesentery, as shown by the cross marks in text-figure II, the single-lobed portion being limited to its terminal part, which is almost straight and in no case thrown into the complicated folds and branchings seen in the brachycnemes.

The filament throughout its trilobed portion, except in its uppermost part, may give rise to craspedonemes, but considerable differences occur in the different species in the extent of the development and distribution of these structures. In *C. membranaceus* and *C. americanus* they occur in considerable numbers and in the form of long slender threads upon the edges of the mesenteries a short distance below the lower border of the stomatodæum, and are quite conspicuous in individuals of these species opened under water so that the craspedonemes may float freely. In *P. fimbriatus*, on the other hand, they are quite inconspicuous, being few in number and having the form of comparatively short digitiform processes rather than elongated threads, but they are to be found at intervals along the entire length of the trilobed portion of the filaments of the macrocnemes, a condition which does not obtain in *C. americanus*, although apparently present in *C. membranaceus*.

The minuter structure of the filaments of *P. fimbriatus* in the trilobed portion is as follows. The mesogloea of the edge of the mesentery is enlarged into a somewhat quadrate mass (Pl. I, Fig. 12), whose distal angles are produced into slender processes projecting at right angles to the plane of the mesentery, while the proximal angles are prolonged into stouter recurved processes. Over this quadrate mass the epithelium is arranged, and it is differentiated into five distinct areas, four of which are paired, while the fifth, which lines the distal face of the quadrate thickening of mesogloea, is unpaired. There can be recognized, therefore, in this portion of the filament a median streak, two distal lateral and two proximal lateral streaks.

The median streak (Fig. 12 *M*) is composed principally of narrow elongated cells, whose nuclei, also long and narrow, are located all at about the same level near the distal ends of the cells. A distinct cuticle lines the free surfaces of the cells, which are provided with strong cilia.

Amongst the cells are a few scattered, elongated gland cells, which stand out very prominently in hæmatoxylin preparations owing to their contents taking the stain very deeply. No nematocysts occur in this portion of the filament, but in its lower layer, and resting upon the mesogloea, are a few muscle fibres, over which are indistinct indications of what is, presumeably, a nerve layer.

On either side of this median streak is a distal lateral streak (*DL*), whose cells are somewhat longer than those of the median streak, so that the latter occupies the floor of a rounded groove between the two distal lateral streaks. A close examination shows marked differences in the histological characters of these streaks compared with what was found in the median streak. Thus one notices that there is no distinct layer of cilia on the free surfaces of the streaks and no well-marked cuticular layer; the gland cells are very much more numerous and nematocysts are abundant. The cells of these streaks rest upon the prolongation of the distal angles of the mesogloeal enlargements and no muscle cells could be found in their lower layers.

Finally, resting on the lateral surfaces of the mesogloeal enlargement and on the lateral faces of the distal and proximal prolongations of its angles are the proximal lateral streaks (*PL*), which are composed entirely of slender cells, whose nuclei are near the free surface and which bear strong cilia. The cells which immediately succeed the distal lateral streaks are as high as these, but they gradually diminish in height as they are traced proximally, until those lining the proximal angular processes of the mesogloeal enlargement are very much lower. In consequence of this the streaks have a U-shaped form in section, the rounded lower portion of the U resting on the lateral surface of the mesogloeal enlargement, while the uprights rest upon the distal and proximal angular processes. No glands, nematocysts, or muscle cells occur in these streaks.

It is to be noticed that the endoderm of the mesentery immediately adjoining the proximal lateral streaks is composed of an epithelium whose scattered spherical nuclei are situated near the free surface, the basal portion being clear and having a somewhat reticular appearance.

In *C. americanus* the structure of the corresponding portions of the filaments is essentially the same, the only differences to be observed being a greater breadth of the median streak, a slightly better development of its muscle cells and a more spherical or oval form for its nuclei and those of the proximal lateral streaks.

With regard to the structure of the craspedonemes, it is clear that they are really folds of the edge of the mesentery over which the filament passes, so that an ascending and a descending portion of it may be recognized as the HERTWIGS pointed out. In *P. fimbriatus* they are in all cases comparatively broad and low, so that the ascending and descending limbs are separated by a rather broad band of endoderm (fig. 13). The proximal lateral streaks are always well defined in them, but some difference is to be found in the structure of the distal streaks as the region where the trilobed portion of the filament passes over into the simple portion is approached. In a section of a craspodoneme of a macrocneme, in which the trilobed portion of the filament extends almost the entire length of the mesentery, the structure of the limbs is exactly the same as in the filament proper, a median and two pairs of lateral streaks being clearly discernible. But if a section be taken of a craspodoneme from one of the brachycnemes, in which they occur only immediately above the region where the single-lobed

portion of the filament begins, or if it be taken from near the terminal portion of a macrocneme, it will be found that the median streak has become very much reduced in size or may be quite absent (fig. 13), so that the distal portion of the filament is simple instead of bilobed and its entire epithelium has the character of the distal lateral streaks.

In *C. americanus*, as has been stated, bunches of craspedonemes occur on the brachycnemes just above where the simple portion of the filament begins. Sections of these show exactly the same structure as the broader and shorter craspedonemes of *P. fimbriatus* found in the same regions, except that the endoderm separating the ascending and descending limbs is very much reduced in size, so that the entire craspedoneme has a quadrilateral appearance in section (fig. 14).

In the simple portion of the filament (fig. 15) the structure of the epithelium is very similar to that of the distal lateral lobes of the trilobed portion. It contains numerous nematocyst and gland cells, justifying the term Nesseldrüsenstreif generally applied to the corresponding structure in the Actiniacea. No muscle fibres could be distinguished in the deeper layers of the epithelium, although a finely granular structure immediately above the mesogloea probably represents nerve fibres.

The distribution of the acontia has already been described, and concerning their structure I have nothing to add to what has been given by VAN BENEDEN (1898). I have not been able to find them in the adult individuals examined.

It may not be a safe procedure to attempt to deduce from the conditions in the adult the origin of the different portions of the mesenterial filaments. The HERTWIGS and VON HEIDER have come to diametrically opposite results by this method of study, the former maintaining that the filaments of the Cerianthids are of endodermal origin, while the latter regarded them as downgrowths of the stomatodæal ectoderm. The relations of the filaments to the stomatodæal ectoderm which I have observed in *P. fimbriatus* and *C. americanus* are so definite as to point strongly to the origin of the upper trilobed portion from the stomatodæal ectoderm as VON HEIDER supposed, but the evidence regarding the lower single-lobed portion is very imperfect and I do not propose to consider this portion in what follows.

A transverse section through the stomatodæum shows that the mesenteries are attached to that structure in such a way as to alternate with the longitudinal ridges which traverse it. An examination of the stomatodæal ectoderm near its lower border will show that there are decided differences between the epithelium covering the ridges and that lining the depressions between them. At the summits of the ridges the gland cells and nematocysts are exceedingly abundant, while upon their sides and in the intervening valleys both these elements are few in number and a distinct cuticle and strong cilia are present. In other words, in their histological structure the summits of the ridges agree with the distal lateral streaks of the trilobed portion of the filaments, while the epithelium of the sides of the ridges and of the valleys is closely similar to that found in the proximal lateral streaks of the filaments. If any dependence is to be placed on histological structure in such a case, it would seem that the distal and proximal lateral streaks of the trilobed portion of the filaments are of ectodermal origin, but as to the nature of the median streak my preparations give no definite information.

Classification. Until 1898 no attempt was made to divide the order Cerianthea into other than generic groups, but in that year VAN BENEDEN recognized two suborders in the larvæ he described, the Botrucnidiferæ and the Acontiferæ. The Acontiferæ are characterized by the marginal tentacles appearing in the same order as the intermesenterial chambers with which they communicate, the unpaired median tentacle, however, always appearing later than the next adjacent couple; certain of the mesenteries bear acontia but never botrucnidæ. In the Botrucnidiferæ, on the other hand, the order of succession of the marginal tentacles, after the appearance of the first three couples, does not correspond with that of the mesenterial chambers, but they appear on either side in alternate chambers, the intervening chambers developing their tentacles only later, probably simultaneously with the appearance of the median tentacle; none of the mesenteries bear acontia, but a greater or less number of them are provided with botrucnidæ. These characters seem to definitely limit two groups.

In my discussion of the arrangement of the mesenteries of the Cerianthea (p. 9 et seq.) I have shown that in the forms with which we are at present familiar two principal types are recognizable. In one of these the telocnemes are formed from the second couple of protocnemes and in the other they are formed from the fourth couple. This seems to be a difference of considerable importance, and on the strength of it I would recognize in the Cerianthea two families, in one of which, the family *Cerianthidæ*, the telocnemes are the second couple from the mid-ventral line, while in the other, for which the term *Arachnactidæ* may be employed, the telocnemes are the fourth couple.

We have then two sets of characters which seem to be of greater than generic importance and the question arises as to what relation, systematically, they bear to one another. The question is at present a very difficult one to answer. An examination of the known larval Botrucnidiferæ seems to indicate that in some members of the group the second, in others the fourth protocnemes form the telocnemes, just as is the case in the Acontiferæ. Thus, in *Calpanthula guineensis* it would seem that the telocnemes were to be formed from the second protocnemes, while in *Hensenanthula dactylifera* and *H. melo* it is probable that they are formed from the fourth protocnemes. What may be the final result in *Cerianthula mediterranea* and *H. spinifer* is less certain; in the larvæ studied the second protocnemes were the longest, but this condition may be corrected in older stages, the known larvæ of both species being in a much earlier stage of development than those of the other forms. In the only adult form known to be botrucnidiferous *Botryanthus benedeni* (Torrey and Kleeberger, 1909), the telocnemes were formed by the fourth protocnemes.

Accepting this conclusion, if VAN BENEDEN's groups be regarded as the more inclusive, both arrangements of the telocnemes will be found in each group, and, conversely, if the telocnemic conditions be taken to represent the larger division, then included in each of these divisions there will be both acontiferous and botrucnidiferous forms. This is not inherently impossible, but it is a difficult matter to decide which is the more primitive character. The occurrence of botrucnidæ is associated with an alternating development of the deuterocnemic tentacles and that of acontia with their successive development. VAN BENEDEN's groups, having thus two associated characters, seem to have the claim to the higher rank.

It must be recognized, further, as indicating the importance of the botrucnidæ as a classificatory factor, that their distribution differs markedly from that of the acontia. While, so far as is known, acontia occur only on the second and fourth protocnemes and on the second deuterocnemes, and, furthermore, only on two of these mesenteries at the most, i. e. on either the second and fourth protocnemes or on the fourth protocnemes and the second deuterocnemes (*P. oligopodus*), the distribution of the botrucnidæ is much more extensive. Thus in *Cerianthula mediterranea* and *Calpanthula guineensis* they occur on the second, third and fourth protocnemes; in *Hensenanthula spinifer* and *H. melo* on the same three protocnemes and on a certain number of deuterocnemes as well, the first in the one case and the first, second and third in the other; and in *H. dactylifera* they occur on the third protocneme and on the first second and third deuterocnemes [1]). Finally in *Botryanthus benedeni* they are stated to occur on all the brachycnemic mesenteries and to be limited to these. The most striking feature of this distribution is the occurrence of botrucnidæ on the third protocneme in all the larval forms and on brachycnemic mesenteries in both larval forms and Botryanthus, mesenteries upon which acontia have never yet been observed.

In view of these facts, and until a fuller knowledge of adult forms is available it seems more convenient to assign the higher rank to VAN BENEDEN's groups and to recognize in the Cerianthеæ two suborders, the Acontiferæ and the Botrucnidiferæ. The latter will contain the genera Cerianthula, Hensenanthula, Calpanthula and Botryanthus, while the former may again be divided into the two families mentioned above, the Cerianthidæ containing the genera Cerianthus, Apiactis, Solasteractis [2]) and Peponactis, and the Arachnactidæ containing the genera Arachnactis, Pachycerianthus, Dactylactis and Ovactis.

No Botrucnidiferæ occur in the present collection.

Suborder ACONTIFERÆ van Beneden.

Cerianthеæ in which the second or fourth protocnemes, or in some cases both these mesenteries, are provided with acontia at least during the early stages of development. The deuterocnemic marginal tentacles appear in the same order as the mesenteries to which they correspond.

Family CERIANTHIDÆ.

Acontiferæ in which the second couple of protocnemes are the telocnemes. The succeeding protocnemes are represented by a brachycnemic couple, usually sterile, and by a macrocnemic couple. Acontia are borne in larval stages upon the telocnemes and in some cases also upon the macrocnemic protocnemes.

1) This marked difference in the distribution of the botrucnidæ in *H. dactylifera* from what obtains in the other two species assigned to that genus suggests a possibility that it might be well to regard spinifer and melo as representatives of a distinct genus. It may be noted that the form of the tentacles of *dactylifera* is decidedly different from what is shown for the other two species.

2) The occurrence of the acontia has not yet been determined in the genus Solasteractis, which is known only from a single example in which the acontia had not developed. The genus may eventually require transference to the family Arachnactidæ.

Genus **Cerianthus** Delle Chiaje.

Synonomy: *Tubularia* Spallanzani, 1784; Gmelin, 1788; Rapp, 1829.
Actinia (pars), Renier, 1804.
Moscata Renier, 1828.
Moschata De Blainville, 1830.
Cereus (pars), Ilmoni, 1830.
Cerianthus Della Chiaje, 1830.
Saccanthus (p.p.), Milne-Edwards, 1857.
Bathyanthus (p.p.), Andres, 1883.
Dianthea (juv.), Busch, 1851.

Acontiferæ living imbedded in mud or sand and provided with a sheath consisting of felted nematocysts and mucus; mesenteries and tentacles usually numerous, so that the quartette arrangement of the deuterocnemes is distinct. Type *Cerianthus membranaceus* (Gmelin) 1788.

It is difficult in the present state of our knowledge to give a satisfactory definition of the genus Cerianthus. The majority of the forms which have been referred to it have been so imperfectly studied that it is impossible to tell whether they really present the structural characteristics of the Acontiferæ or even of the family Cerianthidæ, while the characters of those that have been thoroughly described are rather of specific than generic value, except where they are of ordinal or family importance. Some of the forms show decided departures from the type species in the number of mesenteries, the number and arrangement of the tentacles and the distribution of the gonads, but until a much larger number of forms has been carefully studied as to their structural peculiarities the proper limitations of the genus must remain undetermined. Practically the only generic characters at present available are the mode of life and the occurrence of the sheath, characters which can hardly be regarded as sufficient for the delimitation of the genus, although they serve to separate it from the other genera of the family which at present are known only in larval stages. It is probable that further observations will necessitate the recognition of a number of distinct genera, all of which will present the œcological characters of Cerianthus, but will differ in structure.

As to the synonomy of the genus, it is a question whether the time honoured and appropriate name of Cerianthus should not be replaced by Moschata. The type species, *C. membranaceus*, was first recognized by Spallanzani (1784), who somewhat doubtfully referred it to the genus Tubularia. Gmelin (1788) first assigned to it a specific name, termining it *Tubularia membranacea*, and Rapp (1829) attributed his species *solitaria* to the same genus. In 1804 Renier [1]) redescribed *C. membranaceus* as *Actinia cylindrica*, and again in 1807 as *Actinia vestita*. Still later, in 1828, the same author bestowed another name upon the species, terming it *Moscata rododattila* but this, on account of its form, cannot be taken as establishing the generic name. In the latinized form Moschata, however, it was accepted by de Blainville in 1830. The possible of Moschata has been however, entirely overlooked, the name Cerianthus,

1) I have not been able to consult the various original memoirs of Renier. The statements here made concerning their contents are based upon the edition of his works published in 1847 by Meneghini (Renieri, S.A., Osservazioni postume di zoologica adriatica, per cura di Meneghini. Venezia. 1847).

proposed by DELLA CHIAJE in 1830 [1]) being universally adopted. If this date for DELLA CHIAJE's genus be correct, then both it and MOSCHATA belong to the same year, and in the absence of information as to which really had priority, it seems advisable to retain the name which has been so generally employed.

Regarding the remaining synonyms little need be said. ILMONI's reference of his *Cereus cupreus* to OKEN's genus Cereus is evidently erroneous, that genus being founded upon the form now known as *C. pedunculatus*, and FORBES' reference of his *vestita* to *Edwardsia* is also an error. MILNE-EDWARDS' Saccanthus, characterized by the absence of a terminal pore and by the mesenteries being all nearly of equal length, although accepted by ANDRES (1883) is too imperfectly described to be retained, especially as its definition does not suffice to distinguish it from Cerianthus. Bathyanthus, erected by ANDRES (1882) for MOSELEY's *C. bathymetricus* (1877), may be a good genus, possibly equivalent to and therefore supplanting ROULE's Pachycerianthus, but MOSELEY's description of the single individual examined is too incomplete for certainty. Finally, it seems tolerably certain that BUSCH's *Dianthea nobilis* (1851) is the larval form of *Cerianthus membranaceus*.

1. *Cerianthus ambonensis* Kwietniewski.

Synonym: *Cerianthus ambonensis* Kwietniewski, 1898.

Stat. 181. Amboina anchorage, reef. 1 ex.
Stat. 213. Saleyer anchorage, reef. 1 ex.

General Form. — The column (Pl. I, fig. 1), after preservation in alcohol, is stout, the broadest part being about 2.5 cm. from the margin, whence it tapers gradually towards

1) A great deal of confusion occurs in the literature as to the date of the establishment of this term. HAIME (1854) mentions as references to it DELLA CHIAJE's Descr. e notom. degli animali invert. Sic. cit. 1841 and also the same author's Mem. sulla storia e notomia degli animali senza vert. del regno di Napoli (1829). L. AGASSIZ in his Nomenclator Zoologicus (1842) does not mention it although he gives MOSCHATA. MILNE-EDWARDS (1857) refers it to DELLA CHIAJE's work of 1841, and it is so referred by SCUDDER in his Nomenclator Zoologicus (1882). VON HEIDER refers it to DELLA CHIAJE's Neapolitan work but gives the date 1828, and ANDRES assigns its establishment to DELLA CHIAJE's Instituzioni d'Anat. comp. 1832, but refers the species *C. cornucopiæ* to the work on the Neapolitan invertebrates, giving the date for this as 1830. FAUROT (1895) gives its date as 1829.

The facts of the case, so far as I have been able to trace them, are as follows. DELLA CHIAJE's Memorie sulla storia e notomia degli animali senza vertebre del regno di Napoli was published as four volumes of text and one volume of plates. The text-volumes appeared during the years 1823—1828, but none of them contains any description or mention of Cerianthus. The name first appears at the bottom of Plate 82 as the designation of one of the species figured thereon, it being named *Cerianthus cornucopiæ*, the same name being again used for a form represented on Plate 103. Neither of these Plates is described in the text, the last plate referred to in Vol. IV being Plate 69. The question as to the date of establishment of the genus Cerianthus rests, therefore, on the date of publication of Plate 82. The title-page of the volume of plates bears the date 1822, but there are reasons for doubting that this represents the date of publication of Plate 82. For there is considerable variation in the number of plates contained in different copies of the volume, some containing only 69 plates, the number described in the text volumes, while others contain 74, 89, or 109. It seems probable that DELLA CHIAJE contemplated the publication of a fifth volume of text in which the forms figured on Plates 70—109 would have been described, but this volume was never published, and the inference is that the publishers, in the later issues of the plate volume bound in some or all of the previously unpublished plates, which, as may be concluded from the date of the plate volume (1822), had been printed before the publication of the first text-volume. It becomes a matter of interest therefore, to ascertain the date of issue of these later copies of the plate volume, the date on the title-page being insufficient evidence. The only evidence I have been able to obtain on this point, after many inquiries, was kindly supplied by Dr. E. SCHOEBEL, who informs me that in the copy of the work in the library of the Naples Zoological Station, each plate from Plate 70 to Plate 109 bears the date 1830. It seems probable, on the evidence available, that this is the date of the publication of Plates 82 and 103, and, accordingly, the date of the establishment of the genus Cerianthus.

It may be noted that on Plate 80 there are figures of *Actinia elongata* and *Zoanthus arenaceus*, and 1830 may therefore be accepted as the date of establishment of these species also.

the aboral pole. Below the margin about 1.25 cm. there is a marked constriction, above which are a number of distinct longitudinal furrows extending to the margin and giving the upper part of the column a distinctly striated appearance. Elsewhere the column is smooth, except for irregular wrinkles, evidently due to contraction.

The marginal tentacles were numerous, numbering considerably over one hundred, and were apparently arranged in three cycles. They were almost half the length of the column and were for the most part strong, stout structures, tapering rather suddenly toward the tips, although many were slender throughout so that they might well be described as filiform. The labial tentacles were also numerous, probably the same number as the marginals, but were more slender and much shorter, hardly projecting beyond the margin of the concave disk. The dense crowding of the tentacles and the poor state of preservation prevented a determination of the arrangement of either the marginal or the labial set, nor was it possible to determine the presence or absence of the unpaired labial tentacle.

Dimensions. — Length of the column, 11 cm.; greatest diameter, 3.5 cm. Length of the marginal tentacles, about 5 cm.; diameter just above their insertion 3.5—4.0 mm. Length of the labial tentacles, about 2.0 cm.; diameter just above their insertion 1.0—1.5 mm.

Colour. — The column is throughout its entire extent of the usual dark purple-brown colour; the marginal tentacles were of a light chocolate colour towards their tips, becoming paler proximally. The labial tentacles and the disk and stomatodæum were coloured similarly to the marginal tentacles, the siphonoglyph, however, being colourless.

Structure. — The stomatodæum is short throughout the greater portion of its extent, measuring only 7 mm. in breadth at a point about 1 cm. distant from the siphonoglyph. The latter structure, however is prolonged downwards for a distance of 2 cm. and is very well marked.

The column wall is thick and the mesogloeal processes which support the ectodermal muscle fibres are well developed and closely set. The ectodermal musculature of the disk and marginal tentacles is also well developed that of the labial tentacles, however, being feeble, consisting of little more than a single crenated layer of muscle fibres, the mesogloeal processes being hardly developed.

The state of preservation was too poor to allow of any study of the histological peculiarities of the various parts, nor was it possible to determine by dissection the arrangement of the mesenteries, the disintegrated endoderm matting them together so that they could not be separated. This much, however could be determined, that a considerable number of mesenteries extended to within 2 cm. of the aboral pole of the body, and that a single couple, which I take to be the second couple of protocnemes, extended still further down, reaching the aboral pole. By taking transverse sections at different levels of a strip of the column whose breadth, starting at the mid-ventral line, amounted to about one-eighth of the entire circumference, it was possible to determine the general arrangement of the mesenteries with approximate accuracy. All the mesenteries in this strip, the directive included, this being readily recognizable by the greater thickness of its mesogloea, extended to a distance of almost 3 cm. below the lower border of the stomatodæum; below this level the directive and each alternate mesentery lateral to it had disappeared, the remaining mesenteries, as stated above, continuing downward to

about 2 cm. from the aboral pole. There is evidently then, a clear distinction of the two sets of mesenteries, the brachycnemes and the macrocnemes, but whether the quartette arrangement is manifested by the alternate mesenteries of each set being shorter, I could not determine, although if present the difference in length must be comparatively slight. It is noticeable, too, that a marked diminution in the length of the mesenteries as the mid-dorsal line is approached, is but slightly pronounced, the great majority of the macrocnemes extending to the distance from the aboral pole mentioned above. In order to make clear the arrangement which may be supposed to exist from the observations recorded above, a diagram of what I take to be the condition is appended (Text-figure V), but it must be remembered that this represents only the arrangement on the strip studied by means of sections and that the relative lengths of the mesenteries of the two groups are conjectural. It may be added that in the strip examined sixteen mesenteries were counted, which would give 128 as the total number, and this agrees well with the estimated number of tentacles.

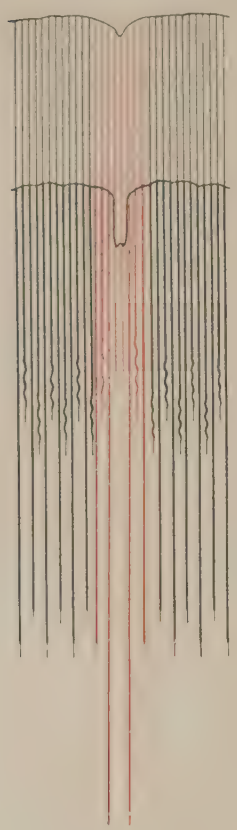


Fig. V.
Diagram showing the arrangement of the mesenteries of *Cerianthus ambonensis*.

In one important particular the mesenteries differ from those of other forms that have been examined, and that is in all the mesenteries with the exception of the directives being fertile. The species is hermaphroditic both ova and spermatozoa occurring in the same mesentery, and they are found as well on the brachycnemes as on the macrocnemes. This is a marked departure from what is found in other Cerianthans, but it does not seem to be a peculiarity which demands the recognition of a new genus, especially as but a single example of the species, and that not in the best state of preservation was available for study.

I identify this form with KWIETNIEWSKI's *Cerianthus ambonensis* with some hesitation, since in the description given by that author only external characteristics are for the most part referred to. The general dimensions of the two forms are, however, very similar, in both a large number of mesenteries extend to the vicinity of the aboral pole, and both come from the same locality. These particulars seem to warrant the assumption of their identity.

2. *Cerianthus sulcatus* Kwietniewski.

Synonym: *Cerianthus sulcatus* n. sp. Kwietniewski. 1898.

Stat. 181. Amboina anchorage, reef. 1 ex.

General Form. — The single example (Pl. I, Fig. 2), preserved in alcohol, had much the same form as *C. ambonensis*, that is to say, it was rather short in proportion to its length, with a constriction about $^1/_2$ cm. below the margin, enlarging below this to almost the diameter of the margin and then tapering gradually to the rounded aboral extremity. The

longitudinal striation of the column wall, mentioned by KWIETNIEWSKI, was but slightly pronounced and if I am right in my identification, cannot be considered characteristic of the species.

The marginal tentacles were long and slender, and numbered 81. They were apparently arranged in four cycles, their formula being

— 1, 4, 2, 3 | 1, 3, 2, 4 ‖ 1, 2, 1, 2, 1, 2, 1 ‖ 4, 2, 3, 1 | 3, 2, 4, 1 —.

The labial tentacles were about one-third the length of the marginals and were of the same number, the median tentacle being present, although considerably shorter than the others. The formula for their arrangement in cycles was apparently

— 2, 1, 3, 4 | 2, 3, 1, 4 ‖ 3, 1, 4, 2, 4, 1, 3 ‖ 4, 1, 3, 2 | 4, 3, 1, 2 —.

Dimensions. — The length of the column was 4 cm.; its diameter at the margin 2.5 cm., and at the middle of the column 2.0 cm. The length of the marginal tentacles was 3.0—3,5 cm., and their diameter at the base was 1 mm.; the length of the labial tentacles was 1.0—1.2 cm., and their diameter at the base about 1 mm. The length of the stomatodæum was 1.2 cm.

Colour. — The column was of a rather pale purple-brown, becoming lighter towards the margin. Both sets of tentacles were almost colourless, a slight tinge of purplish-brown being visible in some of them and appearing to indicate that their colourless condition was the result of preservation. The stomatodæum was pale, almost salmon-colour, and the siphonoglyph colourless.

Structure. — The muscle processes supporting the ectodermal musculature of the column wall were well developed and showed a tendency to arise in groups from conical elevations of the mesogloea, a tendency which was less pronounced near the margin than lower down.

As in the case of *C. ambonensis* the parts were too much macerated to allow of histological study, but by combining the study of sections with dissections, it was possible to make out the arrangement of the mesenteries, so far as their relative lengths were concerned (Text-figure VI). The directive mesenteries extended to a distance of 9 mm. below the lower border of the stomatodæum and were succeeded on either side by a telocneme which extended to the aboral pole. The third couple of protocnemes extended to about 1.2 cm. below the stomatodæum and the fourth couple to about 1.7 cm. The deuterocnemes of the first quartette showed the typical alternating arrangement so far as the brachycnemes were concerned, but no decided alternation of length was discernible in the macrocnemes, these being for the most part of about the same length as the fourth couple of protocnemes, diminishing slightly, however, toward the dorsal mid-line.

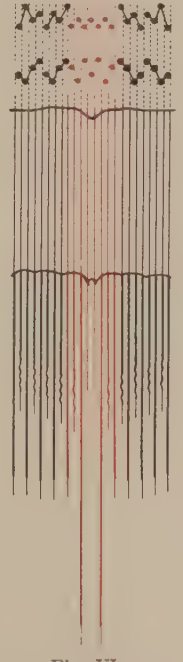


Fig. VI.
Diagram showing the arrangement of the mesenteries of *Cerianthus sulcatus.*

The presence or absence of craspedonemes on the upper portions of the mesenteries could not be determined, but they occurred throughout the length of the telocnemes in considerable numbers and were slender in form. No reproductive cells were observed in any of the mesenteries.

It is again with considerable hesitation that this form is identified with KWIETNIEWSKI's *C. sulcatus*, its dimensions and the fact that it was taken in the same locality being the date upon which the identification is based. The possibility of its being a young individual of *C. ambonensis* is not excluded, although it seems improbable.

3. *Cerianthus tædus* n. sp.

Stat. 85. Lat. 0° 36′.5 S., long. 119° 29′.5 E. Makassar Strait. 724 metres. 1 ex.

General Form. — The column is cylindrical (Pl. I, fig. 3), enlarging slightly near the margin but not tapering to any marked degree toward the rounded aboral pole. The marginal tentacles are relatively short and slender, and appear to be arranged in only two cycles, their formula being

— 2, 1, 2, 1 | 2, 1, 2, 1 ‖ 2, 1, 2, 1, 2, 1, 2 ‖ 1, 2, 1, 2 | 1, 2, 1, 2 —.

The oral tentacles are almost the same length as the marginals, except the median one, which is very much smaller than the rest. They are arranged in four cycles, their formula being

— 1, 2, 4, 3 | 1, 2, 4, 3 ‖ 1, 3, 4, 2, 4, 3, 1 ‖ 3, 4, 2, 1 | 3, 4, 2, 1 —.

In addition to the seven protocnemic oral tentacles there were also five quartettes on either side of the middle line, as well as some additional tentacles, possibly an additional quartette, so that the total number of oral tentacles was not far from 55 and the number of the marginals was the same.

Dimensions. — Length of the column 6.0 cm.; diameter at about the middle of its length 0.6 cm.; diameter at the margin 0.9 cm. Length of the marginal tentacles 0.7 cm.; length of the oral tentacles about the same.

Colour. — The column, in the single example preserved in formalin, was colourless throughout the greater part of its extent, becoming, however, purple-brown toward the margin. Both the oral and marginal tentacles were colourless while the disc and stomatodæum were of a pale chocolate-brown colour.

Structure. — I am not able to give a full account of the structure of this form. The musculature of the column wall is well developed and the stomatodæum was about 0.8 cm. in length, the measurement being taken a little to one side of the siphonoglyph, which is, however, but slightly prolonged. The most striking feature observed on laying open the column longitudinally was the smoothness of the lower 2.5 cm. of the column wall, none of the mesenteries, not even a pair of telocnemes, extending to the aboral pole or even to its vicinity.

Several important points regarding the arrangement of the mesenteries must be left uncertain, owing to an unfortunate error having occurred in making preparations of the single example of the species in the collection. It is certain, however, that the mesenteries were alternately sterile and fertile, that is to say, that brachycnemes and macrocnemes alternate, and furthermore, there were strong indications that the deuterocnemes showed the quartette arrangement, but what the sequence in each quartette was I could not determine. It may be said,

however, that the relative widths of the brachycnemes and the level at which they lost their ciliated lobes of their filaments seemed to show that the longer one was the second in each quartette; the relative lengths of the macrocnemes could not be determined. If this be the actual sequence of the brachycnemes it constitutes a third type of arrangement of the deuterocnemes, differing from the two mentioned above (p. 15), but I do not feel sufficient confidence in the reliability of my data to describe it definitely as a type.

So far as could be ascertained the mesenterial filaments had the usual cerianthan arrangement and structure, but my preparations did not show any craspedonemes, although I cannot state positively that they were absent. The fertile mesenteries contained both ova and spermatozoa, the species being therefore hermaphrodite.

Larval Forms.

Genus **Apiactis** van Ben.

Synonym: *Apiactis* van Beneden, 1898.

Cerianthidæ whose larval forms are more or less conical is shape, with no constriction of the column wall immediately below the bases of the tentacles. Marginal tentacles short, digitiform; the median tentacle developes early, and the remaining ones quickly succeed the corresponding mesenteries. The oral tentacles are small, tuberculiform. Siphonoglyph and directive mesenteries short. Acontia in some cases slow in development.

I have modified VAN BENEDEN's definition of the genus so that it will include the form to be described below, which seems most naturally referable to Apiactis, although it differs from the type species in numerous details.

4. *Apiactis obconica* n. sp.

Stat. 136. Ternate anchorage. Plankton. 1 ex.
Stat. 165. Anchorage on North-east side of Daram Island, (False Pisangs), east coast of Misool. Plankton. 1 ex.
Stat. 172. Anchorage between Gisser Island and Ceram-Laut. Plankton. 3 ex.
Stat. 184. Anchorage off Kampong Kelang, south coast of Manipa Island. Plankton. 1 ex.

General form. — The column is conical in form, the aboral pole being truncated as shown in Pl. I, fig. 4 and 5, two of the examples from Stat. 172, however, being rounded at the aboral pole and much less tapering. The summit of the column is surrounded by a circle of marginal tentacles varying in number from 16 to 19, short and digitiform in shape and the one corresponding to the directive mesenteries somewhat smaller than the rest (fig. 4). The oral tentacles are small and tuberculiform and, indeed, could not be distinguished clearly in all the specimens, nor could they be readily identified in sections. In one example, in which they were especially distinct, they were nine in number, four on one side of the median line and five on the other, the most medial on each side corresponding to the second intermesenterial chamber on each side of the directive chamber, the three median chambers being without corresponding oral tentacles.

Dimensions. — The length of the column was 2.0—2.5 mm. and its diameter at the margin was about the same.

Colour. — The column and oral disc had a faint brownish tinge and the tentacles were a deeper shade of the same colour.

Structure. — The general arrangement of the mesenteries is shown in the text-figure VII, which represents a plan of one of the specimens reconstructed from serial sections [1]). The oral tentacles have, however, been added from another individual, since in the one selected for reconstruction they could not be clearly identified.

The siphonoglyph is but feebly marked and is not prolonged aborally, although the directive mesenteries extend some distance below its lower border. The second protocnemes, counting laterally from the directives, are provided with mesenterial filaments throughout nearly their entire length, the filament being of the trefoil form down to a short distance above its termination. These mesenteries are also the longest and just above their termination each bears an acontium. This combination of characters distinguishes them from all the other mesenteries and clearly marks them as the telocnemes.

Fig. VII.
Diagram showing the arrangement of the mesenteries and tentacles of a larva of *Apiactis obconica*.

The two remaining protocnemes are similar to one another in structure, the third being somewhat shorter than the fourth. Each possesses a relatively long trefoil filament, that of the fourth being the longer, and this is succeeded by a well marked branching region, below which the filament disappears. Neither of these mesenteries bears acontia.

Of deuterocnemes there are present on one side five and on the other six, the most dorsal mesentery on each side being quite small and hardly projecting beyond the lower border of the stomatodæum. Among the rest two varieties may be recognized, in one of which the trefoil portion of the mesentery is much shorter than in the other, so that the branching portion begins at a much higher level and there is a longer stretch of it devoid of a filament. It seems proper to regard the mesenteries of this variety as identical with the brachycnemes of the adult forms and those of the other variety as corresponding to macrocnemes, and since the two varieties alternate, there is an indication of the quartette arrangement, the formula for the completed quartettes being *B M b m*.

No reproductive organs occurred on any of the mesenteries. The state of preservation of the specimens examined did not permit of any study of the minuter histological details, but it may be stated that the mesogloea is throughout rather thin and exceedingly so in the mesenteries, a condition very different from that described by VAN BENEDEN for *Apiactis denticulata*.

1) It is to be noted that in this and succeeding reconstructions of larval forms the transverse proportions are arbitrary, while the longitudinal dimensions are drawn to scale, the object being to represent the relative lengths of the parts. The portion of each mesentery represented by a heavy line indicates the portion bearing the mesenterial filament and the wavy portion represents the extent of the branched portion of the filament.

Genus **Peponactis** van Ben.

Synonomy: *Peponactis* van Beneden, 1898.

Cerianthidæ whose larvæ are almost spherical in shape, with short filiform marginal tentacles, which are, in some species, rather late in developing. The median marginal tentacle is similar to the others. The oral tentacles are small, enlarged at their extremity, and notably inferior in number to the marginals. The siphonoglyph is moderately long; the directive mesenteries are prolonged down the column for a considerable distance.

5. *Peponactis pilula* n. sp.

Stat. 37. Sailus Ketjil, Paternoster Islands. Plankton. 1 ex.
Stat. 96. South-east side of Pearl Bank, Sulu Archipelago. Plankton. Numerous ex.
Stat. 148. Lat. 0° 17'.6 S., long. 129° 10'.5 E. Halmahera Sea. Plankton. 1 ex.
Stat. 186. Lat. 3° 10'.5 S., long. 127° 20'.5 E. North side of Manipa Strait. Plankton. 1 ex.

The various examples from these different stations seem to belong to the same species, which presents many differences from *P. æquatorialis* described by VAN BENEDEN (1898).

In form all the specimens were practically spherical (Pl. I, fig. 6) a slight flattening of the oral pole being the only divergence from what would otherwise be a perfect sphere. A slight elongated depression marks the centre of this flattened area. The examples from Station 96 were all transparent, allowing the attachments of the mesenteries to be perceived with great clearness through the column wall, but this was due to the ectoderm having been macerated away over the greater portion of the column, portions of it persisting only in the neighbourhood of the depression at the oral pole. In the examples from Station 37 more of the ectoderm had been retained, and in those from Stations 148 and 186 it was entirely preserved, the specimens being in consequence quite opaque and therefore in marked contrast to those from Station 96.

In *P. æquatorialis* van Beneden noted the occurrence of both oral and marginal tentacles, both sets being minute and filiform. In *P. pilula* no traces of tentacles could be observed either in surface views or in sections. The difference may be due to difference in age, since although the individuals of the two species that were studied were of practically the same size, nevertheless the individuals of *P. æquatorialis* were in a somewhat more advanced stage so far as the development of the mesenteries was concerned.

Dimensions. — The majority of the examples measured from 3.0 to 3.5 mm. in diameter, that from Station 148, however, being somewhat smaller, its diameter measuring only 2 mm.

Colouration. — Most of the specimens were colourless throughout or else showed a yellowish tinge toward the oral pole. The example from Station 37 was, however, yellowish throughout, but whether this was normal or due to discolouration after preservation cannot be determined.

Structure. — The series of sections prepared from the 2.0 mm. example was,

unfortunately, unsuccessful and the account which follows is based entirely upon series prepared from individuals measuring about 3.0 mm. The general arrangement of the mesenteries is shown in the accompanying textfigure VIII, from which it will be seen that in addition to the eight protocnemes, four deuterocnemes were present on either side, a somewhat smaller number than that occurring in individuals of about the same size of *P. æquatorialis*. The first couple of protocnemes were, as usual, short and entirely destitute of mesenterial filaments. The second couple were, on the other hand, the longest of all the mesenteries; for a considerable distance below their separation from the stomatodæum they possessed no filaments, but toward the aboral extremity of each a filament appeared and it terminated after a short course in a well developed acontium. The third couple possessed filaments throughout almost their entire length, these filaments branching in part of their course. The fourth couple resembled the second so far as the arrangement of the filaments was concerned, except that the filaments were even shorter and the acontia smaller.

Fig. VIII.
Diagram showing the arrangement of the mesenteries of a larva of *Peponactis pilula*.

The first and third deuterocnemes on either side resembled the third protocnemes in structure, and the second deuterocnemes resembled the fourth protocneme, except that they possess no acontia: the fourth couple of deuterocnemes were as yet unprovided with filaments.

From the second protocnemes onward the lengths of the mesenteries diminished gradually, the quartette arrangement of the deuterocnemes being indicated only by the structure of their filaments. It seems probable, however, that an alternating difference of the quartette mesenteries will appear with further development, since it is already clearly indicated in the figure of *P. æquatorialis* given by VAN BENEDEN. It is to be noted that in that form as well as in *pilula*, the second protocnemes are the longest of all the mesenteries and this fact, together with the occurrence of acontia upon them in *pilula*, renders it probable that they will become the telocnemes. The presence of acontia in *pilula* is in marked contrast to their absence in the somewhat more advanced individuals of *æquatorialis*.

As regards the finer structure it may be stated that the mesogloea is thin throughout, especially so in the mesenteries where it forms a sheet of extreme tenuity. The ectoderm contains numerous gland cells and at the aboral pole nematocysts were quite abundant, although they were rare over other portions of the column. The ectodermal musculature was well developed, much more so than in VAN BENEDEN's examples of *æquatorialis*, the muscle cells being arranged on quite well developed muscle processes. The stomatodæum presented the same general histological characters as in other forms and possesses a well marked siphonoglyph. No reproductive cells were present in any of the mesenteries.

Family Arachnactidæ.

Acontiferæ in which the fourth couple of protocnemes, counting from the mid-ventral line, form the telocnemes. The second and third couples of protocnemes are sterile. Acontia are borne in larval stages by the fourth protocnemes but never by the second.

Genus **Pachycerianthus** Roule.

Synonym: *Pachycerianthus* Roule, 1904.

Arachnactidæ living imbedded in mud or sand and provided with a sheath composed of felted nematocysts and foreign substances. Mesenteries and tentacles usually numerous and the quartette arrangement of the deuterocnemes distinct. Type *P. benedeni* Roule, 1904.

In 1904 Roule established the genus Pachycerianthus for the reception of a form which had been obtained in the Sea of Japan and which presented the peculiar arrangement of the mesenteries (i. e. the telocnemes were the fourth protocnemes instead of the second) which I have taken as one of the chief characteristics of the family Arachnactidæ. Roule does not, however, seem to have fully appreciated the taxonomic importance of his discovery, and the name which he chose for the genus refers merely to a remarkable thickness of the directive mesenteries.

6. *Pachycerianthus fimbriatus* nov. nom. [1]).

Synonomy: *Cerianthus elongatus* Kwietniewski, 1898.

Stat. 60. Haingsisi, Samau Island, near Timor. Reef. 1 ex.
Stat. 172. Gisser Island. Reef. 2 ex.
Stat. 174. Waru Bay, North coast of Ceram. Reef. 2 ex.
Stat. 213. Saleyer anchorage. Reef. 2 ex.
Stat. 220. Pasir Pandjang, west coast of Binongka. Reef. 2 ex.
Stat. 234. Nalahia Bay, Nusa-Laut. Reef. 3 ex.
Stat. 296. Noimini, south coast of Timor. Litoral. 1 ex.
Stat. 301. Pepela Bay, east coast of Rotti Island. Reef. 1 ex.
Stat. 303. Haingsisi, Samau Island. Reef. 1 ex.

I have already, in the introductory pages, described many of the structural peculiarities of this species, as well as of that which follows, and it will be unnecessary to do more than briefly summarize these here for the better characterization of the species.

It may remarked, in the first place, that the majority of the specimens had been preserved in alcohol, with the unfortunate result that the internal organs were greatly macerated, the mesenteries being as a rule so matted together by their craspeda as to render a proper study of their arrangement almost impossible. Two specimens, however, those from Station 172, had been preserved in formalin, and these were found to be in a most excellent state of preservation both for macroscopic and microscopic examination, so that what follows is largely based upon what was found in these individuals, although various points were confirmed, when possible by an examination of others.

1) For explanation of change of name see foot-note p. 12.

All the individuals were taken in shallow water near the shore or on reefs and many were accompanied by the tube which they inhabited and which had the usual appearance and composition.

The column is elongated (Pl. I, fig. 7) and of the usual Cerianthan form, tapering aborally, where it is provided with a terminal pore, and flaring out somewhat at the margin, upon which the marginal tentacles are situated. These are numerous and rather slender and are arranged in four cycles at the margin of the funnel shaped disc. It was not always easy to distinguish between the third and fourth cycles, but where this could be done the arrangement was found to be

— | 1, 3, 2, 4 | 1, 3, 2, 4 ‖ 1, 3, 4, 2, 4, 3, 1 ‖ 4, 2, 3, 1 | 4, 2, 3, 1 | —.

The labial tentacles were somewhat shorter than the marginals and appear to have an arrangement that may be represented thus

— | 2, 1, 3, 4 | 2, 3, 2, 4 ‖ 2, 1, 3, 2, 3, 1, 2 ‖ 4, 2, 3, 2 | 4, 3, 1, 2 | —.

Kwietniewski (1898) describes the marginal tentacles as arranged in three cycles, but finds four in the case of the labials.

Dimensions. — Different individuals varied considerably in their dimensions. In the two examples from Station 172 (preserved in formalin) the column measured in the one case 10.5 cm. and in the other case 8.5 cm. in length, the diameter at the margin being in each case 2.2 cm. Other individuals (preserved in alcohol) ranged between 15.0 and 4.7 cm. in length, proportionate differences also occurring in the diameters; the measurements of the individuals from Station 172, given above, probably represent a fair average.

The tentacles also present a good deal of variation in length. The marginals were in most individuals about 2.0 or 2.5 cm. in length with a diameter at the base of from 1.0 to 1.5 mm., although in some cases they reached a length of 4.0 cm.; the labials were somewhat shorter, measuring as a rule about 1.5 cm. in length.

Colouration. — The column is of the usual purple-brown colour, varying from a very pale to a very deep shade. The marginal tentacles frequently show traces of a brownish colouration, deeper toward the tips, while the labials are of a light greenish-yellow colour.

Structure. — In its histological features the column wall presents no special peculiarities. The muscle lamellae for the ectodermal muscles, are from 0.4 to 0.6 mm. in height, and are more widely separated than usual, about eight occurring in each 0.1 mm. of a section taken at the level of the lower border of the stomatodæum. A section of *C. sulcatus* taken at the same level showed about 14 lamellae in the same distance and one of *C. americanus* about 17. These differences may, however, be due in part or in whole to differences in contraction. The muscle lamellæ of the tentacles are noticeably better developed than usual, those of the marginal tentacles being about 0.02 mm. in height, while those of the labials are somewhat lower in correspondence with the lesser size of the tentacles.

On opening the column by a longitudinal incision the stomatodæum is seen to have a length of about 1 cm. and to be provided with a well marked siphonoglyph. Throughout the greater part of its extent the ectoderm is thrown into well marked folds, each of which is

supported upon a mesogloeal lamella. In this folded region the ectoderm is rich in gland cells, its cilia are comparatively short and its basal portion is occupied by muscle fibres arranged in a single layer. As the siphonoglyph is approached the folds suddenly cease at about the line of attachment of the first couple of deuterocnemes, and here also the mesogloea thickens markedly. The general character of the ectoderm remains unchanged, however, up to the line of attachment of the second couple of protocnemes, but there the gland cells almost entirely disappear, the muscle fibres also vanish and the cilia become much longer, these peculiarities distinguishing the siphonoglyph from the general stomatodæal surface.

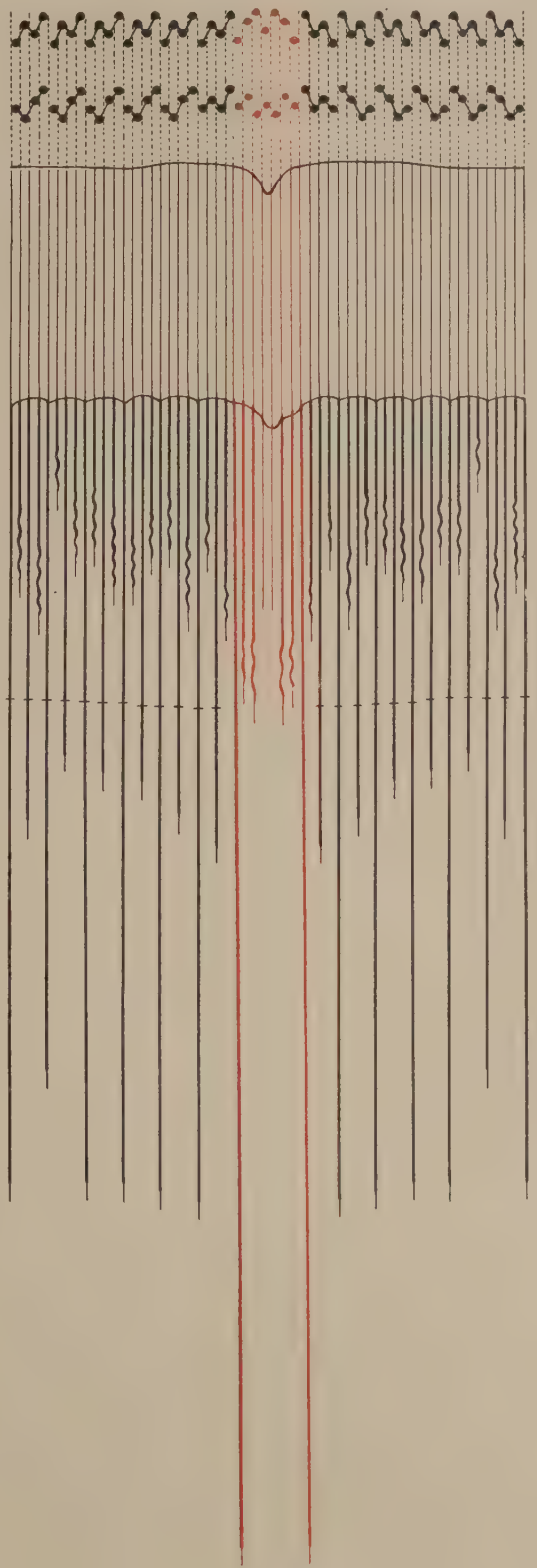


Fig. IX. Diagram showing the arrangement of the mesenteries and tentacles of *Pachycerianthus fimbriatus*.

The arrangement of the mesenteries has been indicated in the introductory portion of this paper and in the definition of the genus, but for the sake of completeness it may be stated again together with certain details previously omitted. The first protocnemes are short (Text-fig. IX) and bear no mesenterial filaments. As in *P. benedeni* they are unusually thick and narrow throughout the extent of their attachment to the stomatodæum. The second and third protocnemes are alike. Each is but a little longer than the first and like it is sterile, although provided with a mesenterial filament which presents the structure usual on microcnemes. The fourth protocnemes are the telocnemes; they are fertile and extend to the region of the aboral pole.

The deuterocnemes are arranged in quartettes, the formula for each of these being *B—m—b—M*. None of the deuterocnemes extend much beyond midway between the lower border of the stomatodæum and the aboral pole, the longer macrocnemes of the six ventral quartettes ending at about this level, while those of the remaining quartettes are gradually shorter toward the dorsal surface. The shorter

macrocnemes of the ventral quartettes extend only about one-third the distance between the stomatodæum and the aboral pole and the microcnemes are, of course, even shorter, the longer ones being slightly shorter than the second and third protocnemes.

Craspedonemes in the form of relatively short digitiform processes, are scattered at intervals along the entire length of the macrocnemes, and the bunches of them, which are so evident in *C. membranaeeus* and *C. americanus* a short distance below the stomatodæum, though present are rather inconspicuous on account of the shortness of the craspedonemes composing them. In structure, also, the craspedonemes differ from those of *C. americanus*, the two limbs of the filament being separated by a distinct band of ectoderm and mesogloea, instead of being practically in contact (compare figs. 13 and 14, pl. I).

All the fertile mesenteries (macrocnemes) contained only ova in the two individuals examined histologically; there was not the slightes trace of hermaphroditism. The ova when fully developed contain a considerable amount of yolk and have a dark brown colour, thus making the macrocnemes especially conspicuous.

Systematic. — The identification of this form with KWIETNIEWSKI's *C. elongatus* (1898) rests upon somewhat uncertain grounds, owing to the insufficiency of the data concerning that species. The form considered here resembles it, however, in the dimensions of the body and tentacles and in that only two mesenteries extend aborally beyond the middle of the column. These similarities, taken with the fact that the two forms come from the same general locality, form the basis of the identification.

It is not improbable that the *C. nobilis* of HADDON and SHACKELTON (1893) may also be identical, but in this case also the data furnished by the sponsors are too incomplete to allow of certainty. The name *nobilis* has priority over *fimbriatus* if the two forms be really identical, but it seems preferable, for the present, to employ a distinguishing term, leaving open the question of the identity with *nobilis*.

7. *Pachycerianthus monostichus* n. sp.

Stat. 181. Ambon anchorage, reef. 2 ex

The two individuals which I refer to this species were both rather short, stout forms with relatively long slender tentacles (Pl. I, fig. 8). The greatest diameter of the column was somewhat below the middle, where it tapered slightly to the rounded aboral extremity and also orally, expanding again a little toward the margin, which was longitudinally ridged.

The marginal tentacles were long and slender and were 47 in number. they were arranged in two cycles, which, for the most part, alternated with one another, although the alternation was not quite regular. The labials were 48 in number and were in marked contrast with the marginals, being, in the first place, very short and, in the second place, arranged in a single series, a condition which suggested the specific name that has been chosen. The median ventral tentacle was present.

Dimensions. — The column measured 4.5 cm. in length, its greatest diameter being

2.0 cm. The marginal tentacles were from 2.5 to 3.0 cm. in length, their diameter at the base being about 1 mm., while the labials had a length of only 2.0 mm.

Colouration. — The column was of a pale violet brown colour, as were also the disc and the labial tentacles. The marginal tentacles were colourless.

Structure. — On laying open the column by a dorsal longitudinal incision, the oral disc is seen to be deeply concave and longitudinally ridged. The stomatodæum possesses a well developed siphonoglyph, on either side of which it becomes markedly longer and then diminishes rapidly as it is traced dorsally, the lower border thus showing a rounded projection on either side of the siphonoglyph.

Fig. X.
Diagram showing the arrangement of the mesenteries of *Pachycerianthus monostichus.*

The protocnemes of the first couple are very short, hardly projecting below the lower border of the siphonoglyph (Text-fig. X). The second and third couples are sterile, the second being about two-thirds the length of the column and the third distinctly shorter. The fourth couple constitute the telocnemes; they are fertile and extend to the aboral pole. The deuterocnemes have a well marked quartette arrangement, the formula for each quartette being S, f, s, F. The larger macrocnemes of the two or three ventral quartettes extend almost to the aboral pole, but those of the remaining quartettes diminish rapidly toward the dorsal surface. The shorter macrocnemes of each quartette are much shorter than the longer ones, those of the ventral quartettes hardly extending to half way between the lower border of the stomatodæum and the aboral pole; the longer microcnemes are slightly shorter than the shorter macrocnemes and the shorter microcnemes extend but a short distance beyond the lower border of the stomatodæum. Craspedonemes occur on the macrocnemes below the stomatodæum, but were not found along the margin of the gonophoric portions of the mesenteries as in *P. fimbriatus.*

Larval Forms.

Genus **Arachnactis** M. Sars.

Synonym: *Arachnactis* M. Sars, 1846.

Arachnactidæ whose larval forms have a spherical body in the early stages, later becoming elongated. Marginal tentacles long and slender, in the earlier stages several times the length of the column; the median unpaired marginal tentacle appears only after the development of these corresponding to the fourth intermesenterial chamber.

The genus Arachnactis was established in 1846 by M. Sars for the reception of *A. albida*, a free-swimming form found in the autumn and winter at Floroe Island, off the coast of Norway. Since its discovery this species has frequently been under observation, notably by Boveri (1890) Vanhöffen (1895), Fowler (1897) and E. van Beneden (1898). The last named author showed that acontia occurred upon the fourth couple of protocnemes, and his figures of forms with nine and thirteen marginal tentacles show that the second and third couples possess a wavy filament, their sterile or microcnemic character being thereby indicated,

while the filaments of the fourth couple are almost straight, an indication that they are destined to be fertile or macrocnemic in character. Add to these indications the facts that in the older larvae studied by VAN BENEDEN the fourth couple of protocnemes were longer than any of the other mesenteries and that in the oldest individual studied by VANHÖFFEN these same mesenteries were decidedly the longest of all and contained immature ova, and their identification as telocnemes seems fairly certain.

In 1862 A. AGASSIZ described another free-swimming Cerianthid larva, which he referred to the genus Arachnactis as *A. brachiolata*, an identification which has remained unchallenged ever since. In 1890 MC INTOSH described a single specimen taken in the Bay of St. Andrews as an Arachnactis, and later VAN BENEDEN (1891) gave a thorough description of a number of individuals in different stages of development, collected by BOURNE off the south-west coast of Ireland and referred to *A. albida*. VAN BENEDEN recognized as the results of his studies that these forms were different from those studied by BOVERI (1889), and in his later paper (1898) identified them with that described by MC INTOSH and named them *A. lloydii*, on the supposition that they would prove to be the young of *C. lloydii*. Previously to this, however, FOWLER (1897) had recognized the fact that the forms studied by VAN BENEDEN and also individuals from Plymouth which he had himself studied were different from *A. albida*, and named them *A. bournei*, which term has the priority, until it is made certain that the forms are really the larvæ of *C. lloydii*.

Both *A. brachiolata* and *A. bournei* present certain marked differences from *A. albida*. Thus, in early stages the body of *albida* is short and almost spherical, while in the other two species it is more elongated and somewhat conical; the tentacles of *albida* are long and slender, their length being many times the breadth of the disc, while in the other two their length is about equal to the diameter of the disc; and in *albida* the median marginal tentacle appears only when the fourth couple of tentacles are already rather long, while in the other two species the median marginal tentacle developes equally with the tentacles of the third couple. How far these differences may be correlated with differences in the arrangement of the mesenteries cannot yet be determined. In the case of *A. albida*, as has already been noted, individuals with gonads and acontia have been observed, and there seems a tolerable certainty that the mesenterial arrangement of these individuals is of the same type as that of Pachycerianthus; but no sufficient data are at present available for the determination of the mesenterial arrangement of either *A. bournei* or *A. brachiolata*. The oldest examples of the latter form that I have been able to obtain possessed only seven tentacles and the mesenterial arrangement was that indicated in the adjoining text-figure (Text-fig. XI). The second couple of protocnemes is much more developed than any of the other mesenteries, but whether this is a temporary condition, or really indicates that they are to form the telocnemes is uncertain.

Fig. XI.
Diagram showing the arrangement of the mesenteries and tentacles in a young larva of *Arachnactis brachiolata*.

But leaving aside the possibility thus indicated it seems that in the certain differences mentioned above there is a valid basis for the separation of *brachiolata* and *bournei* from *albida*, especially since *A. sibogæ*, to be described below, resembles *albida* in the particulars in question.

There are thus two forms, *albida* and *sibogæ*, which may be definitely regarded as representatives of the genus Arachnactis, and two others, *brachiolata* and *bournei*, which should be removed from that genus. What the systematic position of the latter two may be it is a little difficult to say. VAN BENEDEN (1898) has assigned *A. bournei* to *C. lloydii*, principally on the basis that the areas of distribution of the two forms is essentially the same, and if this identification be correct, it may be expected that it will be found that the second couple of protocnemes of *bournei* actually do become the telocnemes. Similarly KINGSLEY (1904), with an equal amount of probability, has regarded *brachiolata* as the larval form of *C. verrillii*, and if both these identifications prove correct the two larval forms must be associated with the *Dianthea nobilis* of BUSCH (1851), which is generally accepted as the larval form of *C. membranacea*.

8. *Arachnactis sibogæ* n. sp.

Stat. 96. South-east side of Pearl Bank, Sulu Archipelago. Plankton. 1 ex.
Stat. 205. Lohio Bay, Buton Strait. 3 ex.
Stat. 282. Between Nusa-Besi and the north-east point of Timor Island. 1 ex.

In the majority of the specimens which may be referred to this species the body is short and almost spherical, but in an individual from Station 205 (Pl. I, fig. 10) it is more elongated and conical, this individual, however, notwithstanding its greater size and difference of form being in practically the same stage of development as the others. The marginal tentacles in all were nine or ten in number, four on each side of the median plane being long and slender, while a median one was much smaller; four or five labial tentacles were present (Pl. I, figs. 9 and 10). The individual from Station 96 differed from the rest in being much smaller and the marginal tentacles, while considerably longer than the breadth of the disc, lacked the almost disproportionate length which they possess in the other examples.

Dimensions. — In the example from Station 96 the diameter of the column was 0.6 mm. and the length of the longer tentacles was 1.5 mm. In the other spherical examples the diameter of the column was 0.75 mm. and the longer marginal tentacles reached a length of 3.5 mm. The conical example from Station 205 had a length of about 1.5 mm., and the diameter at the margin was 0.6 mm.; owing to their contorted form the length of the marginal tentacles could not be determined accurately, but they seemed to be relatively shorter than those of the other examples from the same Station.

Colouration. — All the specimens were completely colourless, the only indication of a possible presence of pigment being a distinct opacity at the tips of the marginal tentacles.

Structure. — The arrangement of the mesenteries is shown in the adjoining, text-figure (Text-fig. XII) prepared from one of the spherical examples from Station 205. In this there were four couples of well developed marginal tentacles, a small median tentacle and on the right side an additional tentacle whose fellow had not yet made its appearance. The labial tentacles were five in number, two couples corresponding to the second and third couples of marginal tentacles, while the odd one was one of an additional couple, developed, like the odd marginal, upon the right side.

The mesenteries were twelve in number, equally distributed on each side of the median

line, although those on the right side were slightly more developed than those on the left. The directives hardly projected beyond the lower border of the stomatodæum, and on either side of them were two mesenteries, apparently of the sterile type, which extended to about half way between the lower border of the stomatodæum and the aboral pole. Next on either side came a long mesentery, extending almost to the aboral pole and bearing each an acontium; these, the fourth couple of protocnemes I take to be the telocnemes. Of the deuterocnemes only two were present on either side of the median line; one of these was of about the same length as the second and third protocnemes and like these apparently of the sterile type, while the other hardly projected beyond the lower border of the stomatodæum and had not yet developed a mesenterial filament.

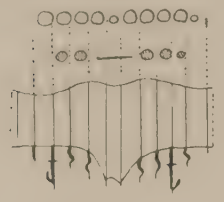


Fig. XII.
Diagram showing the arrangement of the mesenteries and tentacles in a larva of *Arachnactis sibogæ*.

The locality from which *A. sibogæ* was obtained seems to preclude any probability of its identity with *A. albida*. But in addition its distinctness is shown by the earlier development of the acontia, the youngest example of *A. albida* described by VAN BENEDEN not showing them, although it is in a slightly more advanced stage of development than the examples of *A. sibogæ*, possessing thirteen mesenteries and six labial tentacles as against twelve mesenteries and five labial tentacles. Another difference exists in the length of the stomatodæum, which is considerably longer in *A. sibogæ* than in *A. albida*, the mesenteries of the former species thereby appearing somewhat shorter.

Genus **Dactylactis** van Beneden.

Synonym: *Dactylactis* van Beneden, 1898.

Larval Arachnactidæ in which the marginal tentacles in early stages are not very much longer than the column and are continuous on their aboral surface with the column wall, not being separated from it by a groove. Their ectoderm shows more or less distinctly a differentiation into four bands, that of the oral and aboral surfaces being richly provided with nematocysts, while these structures are almost lacking on the lateral surfaces; the median tentacle of the series developes early. The oral tentacles develope early. Column ovoid, or, in early stages, conical. The directive mesenteries are prolonged some distance below the lower border of the stomatodæum and acontia are borne by the mesenteries of the fourth and sixth couples.

9. *Dactylactis malayensis* n. sp.

Stat. 172. Gisser Island, anchorage between this island and Ceram-Laut. Plankton. Numerous examples.
Stat. 185. Manipa Strait. HENSEN vertical net, 1536 m. to surface. 1 ex.

Of this form there were numerous examples, the majority of which, however, had been preserved in alcohol and were considerably distorted and shrunken. A number, fortunately, were most excellently preserved in 4% formalin and these alone were used for study.

In all the body was ovoid in form (Pl. I, fig. 11) and surmounted by a corona of

moderately long tentacles which curved gracefully so that each had somewhat the form of a sickle, as in the *D. armata* figured by VAN BENEDEN (1898), although the additional length of the tentacles in the present species made the curvature more distinct. In some of the smaller individuals, indeed, the tentacles were spread out almost at right angles to the axis of the column as is Solasteractis, but there was no distinct groove marking the junction of their aboral surfaces with the column wall.

Dimensions. — Two distinct stages were represented in the collection. The examples of the younger stage had a column length of about 1.25 mm. and the length of the marginal tentacles varied from 1.0 to 2.0 mm. In the older individuals the length of the column varied from 1.5 to 2.0 mm. and the length of the marginal tentacles was about 2.0 mm., although in one example, owing to a greater contraction, they did not exceed 1 mm.

Colouration. — No colour remained in any of the examples.

Structure. — In the younger individuals there were seventeen marginal tentacles, that is to say, eight couples and a median tentacle. The latter (Pl. I, fig. 11) was indistinguishable by its length from the adjacent tentacles, while both members of the eighth couple and the left member of the seventh couple were decidedly smaller than the others. Of the labial tentacles there were six couples, the first couple corresponding to the second couple of marginal tentacles and the others successively to the third, fourth, fifth, sixth and seventh couples. No labial tentacles corresponding to the median or first couple of the marginals were present, and, employing VAN BENEDEN's symbols the formula for the tentacles would be

$$\begin{matrix} T^8—T^1. & TM. & T^1 + T^8 \\ t^7—t^2 & & t^2—t^7. \end{matrix}$$

The stomatodæum was rather deep, deepest in the region of the siphonoglyph and diminishing gradually thence toward the dorsal mid-line. Twenty mesenteries were present (Text-fig. XIII), an equal number on either side of the mid-plane, although those of the right half of the body were somewhat longer than those of the left half. The directive mesenteries extended some distance below the lower border of the siphonoglyph and were succeeded by two couples provided with mesenterial filaments throughout only a portion of their length. The fourth couple, on the other hand, were provided with filaments throughout almost the whole length of their free border and the filaments terminated in acontia. At this stage, it is to be noted, these acontiferous mesenteries are shorter than those of the second couple. To these protocnemic mesenteries succeed six couples of deuterocnemes, gradually diminishing in length, so that on the left side the last three mesenteries, and on the right side the last two do not extend beyond the lower border of the stomatodæum. The other deuterocnemes, which do extend below the stomatodæum, are provided with mesenterial filaments alternately straight and contorted, except on the left

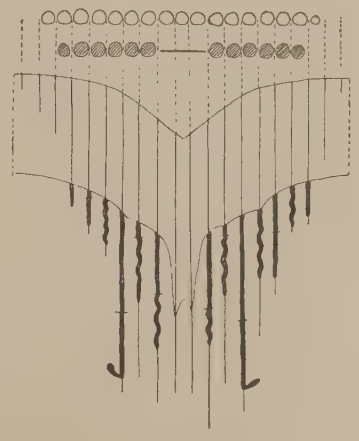


Fig. XIII.
Diagram showing the arrangement of the mesenteries and tentacles in a larva of *Dactylactis malayensis*.

side, where the member of the seventh couple does not yet show the contorted form which it will probably present later. The difference in the form of the filaments may be supposed to indicate an alternation of sterile and fertile mesenteries.

In the larger examples there were twenty marginal tentacles, that is to say, a median tentacle and on the right side ten and on the left nine additional ones, the most dorsal tentacle on each side being markedly smaller than the others. Of labial tentacles there were seventeen, nine to the right of the median line and eight to the left of it. As in the earlier stage there was no median labial tentacle, but the most ventral couple now corresponded to the first couple of marginals, so that the tentacle formula was

$$\begin{matrix} T^{9}—T^{1}. & TM. & T^{1}+T^{10} \\ t^{8}—t^{1}. & & t^{1}—t^{9}. \end{matrix}$$

Compared with the younger examples the most striking difference is this appearance of the first couple of labial tentacles. They are considerably smaller than the second couple and it would seem that their development is practically identical with that of the eighth labial and ninth marginal couples.

As regards the mesenteries, these have increased to twenty-three, twelve of which belong to the right side and eleven to the left. They present essentially the same structure and arrangement as in the younger examples, except that the fourth couple of protocnemes, the acontiferous couple, are now decidedly longer than the second couple (Text-fig. XIV).

Fig. XIV.
Diagram showing the arrangement of the mesenteries and tentacles in an older larva of *Dactylactis malayensis*.

The differentiation of the ectoderm of the tentacles into four bands is fairly distinct, but it is not carried to the extent of giving the tentacles a quadrangular section, the condition they present being somewhat like that described by VAN BENEDEN for *D. elegans*, although the histological details are quite different. On the lateral surfaces the supporting cells are closely packed, gland cells being rare and nematocysts, though present, relatively few. As a result the nuclei are closely packed and in sections stained with haematoxylin these regions are of a deep blue colour, contrasting clearly with the oral and aboral surfaces which are much paler in colour. This is due to the fact that on the aboral surface the nematocysts are very abundant, and on both surfaces there are numerous large unstained gland cells, so that the supporting cells are much less numerous and their nuclei somewhat sparsely scattered.

It is highly probable that this form is different from any of those described by VAN BENEDEN (1898). The individuals of *D. armata* and *D. digitata* which he described are of about the same age or even slightly younger than the younger examples of *D. malayensis*, and yet they show less disparity in the lengths of the protocnemes and deuterocnemes, and in both the fourth couple of protocnemes surpasses in length the second couple. And, as a further

distinction from *D. armata*, it may be pointed out that *D. malayensis* shows no exceptional development of nematocysts in the aboral endoderm of the column, nor do its marginal tentacles present a quadrangular form in section. VAN BENEDEN's examples of *D. inermis* were all in a decidedly earlier stage of development than the younger examples of *D. malayensis*, and a comparison of the arrangement of the tentacles and mesenteries in the two forms is impossible. The section of a marginal tentacle which VAN BENEDEN figures does not show the dense crowding of the nuclei on the lateral surfaces which is so marked in *D. malayensis*, the aboral band is of an entirely different character and the abundance of coarsely granular gland cells throughout both the lateral and aboral areas is quite unlike what occurs in the malayan form. On account of these differences it seems advisable to regard the two forms as distinct. The example of *D. elegans* is even younger than those of *D. inermis*, but its distinctness from *malayensis* may be accepted on the basis upon which VAN BENEDEN separates it from the other forms described by him, namely, on the occurrence of large nematocysts with a spiral thread. These do not occur in *D. malayensis*.

GRAVIER's *D. benedeni* (1904), notwithstanding that its tentacles and mesenteries were but little in excess numerically of those of the older examples of *D. malayensis*, is evidently considerably more advanced in development, and it is difficult to say to what extent the differences seen in the structure of the mesenteries in the two forms may be due to this fact. It is possible that later stages of *D. malayensis* may also show two couples of acontiferous mesenteries and a further development of the deuterocnemes until they resemble those of *D. benedeni* in arrangement. Unfortunately GRAVIER makes no statement as to the presence or absence of a differentiation of the tentacular ectoderm. It seems preferable, in the face of so much uncertainty, to regard the malayan form as distinct for the present.

It is not improbable that *D. viridis* described by VERRILL (1898) may be identical with one of the forms described by VAN BENEDEN, *D. digitata* possibly, as VERRILL himself suggests. The description which has been given of it is, hower, too inadequate for the determination of its specific status, no account being furnished of its structural peculiarities.

Finally, it does not appear probable that *D. malayensis* can be identified with any of the forms recently described by SENNA (1907). Of these *D. mammillata*, captured in the Pacific to the north of the Galapagos Islands, differs in lacking the differentiation of the ectoderm of the tentacles, while the other three forms, *D. discors*, *D. tardiva* and *D. præcox*, all from the Bay of Bengal, differ in the fact that notwithstanding that they possess sixteen marginal tentacles they show no indication of the development of labials, a condition in marked contrast to what occurs in *D. malayensis*.

In addition to the forms described above empty tubes of Cerianthids were taken at the following stations:

Stat. 213. Saleyer anchorage and surroundings.
Stat. 302. Lat. 10° 27'.9 S., long. 123° 28'.7 E., near Rotti Island. 216 metres.
Stat. 313. Anchorage east of Dangar Besar, Saleh Bay.
Stat. ?

All these presented the usual structure which distinguishes tubes formed by Cerianthids, but it is impossible to say by what species they were formed. It may, however, be worth mentioning that the tube from Station ?, as well as those inhabited by individuals of *P. fimbriatus* and taken at Stations 174 and 213, contained imbedded in their substance numerous examples of *Phoronis australis* (compare Haswell 1885).

At Station 95, lat. 5° 43′.5 N.; long 119° 40′ E., Sulu Sea, 52 metres, another empty tube was obtained, which may be that of a Cerianthid, although it is very different in structure from those usually formed by these creatures. It is 13 cm. in length, and has a diameter in its flattened condition of 2.5 cm. The outer surface is transversely wrinkled, while the inner one is almost smooth; it has a pale brown or hempen colour and is rough and somewhat brittle to the touch. In structure it is composed of a loosely felted mass of fine fibres, among which are scattered numerous long monaxial sponge spicules and also some elongated brittle dark-brown setae, whose origin I am not able to determine. The fine fibres which compose the main tissue of the tube resemble nematocyst threads, of which the ordinary tubes are formed, except that they are many times thicker than these. If they are really nematocyst threads, it may be expected that the species which inhabits such a tube possesses nematocysts of an exceptional size.

BIBLIOGRAPHY.

1862. AGASSIZ, A. On Arachnactis brachiolata. Proc. Boston Soc. Nat. Hist. IX. 1862.

1863. —— On Arachnactis brachiolata, a species of floating Actinia found at Nahant, Massachusetts. Journ. Boston Soc. Nat. Hist. VII. 1863.

1842. AGASSIZ, L. Nomenclator zoologicus. 1842.

1883. ANDRES, A. Le Attinie. Fauna und Flora des Golfes von Neapel. IX. 1883.

1891. VAN BENEDEN, E. Recherches sur le développement des Arachnactis. Arch. de Biol. XI. 1891.

1898. —— Die Anthozoa. Ergeb. Plankton-Exped. der Humboldt Stift. II, K. e. 1898.

1830. BLAINVILLE, H. M. Zoophytes. Dict. Sci. Nat. LX. 1830.

1889. BOVERI, TH. Über Entwicklung und Verwandtschaftsbeziehungen der Aktinien. Zeit. für wiss. Zool. XLIX. 1889.

1851. BUSCH, W. Beobachtungen über Anatomie und Entwicklung einiger wirbellosen Seethiere. Berlin. 1851.

1893. CARLGREN, O. Zur Kenntnis der Septenmuskulatur bei Cerianthen und der Schlundrinnen bei Anthozoen. Ofver. Kongl. Vetensk. Akad. Forhandl. Stockholm. 1893.

1900. —— Ost-Afrikanische Actinien gesammelt von Herrn Dr. F. STUHLMANN, 1888 und 1889. Mitth. a. d. Naturhist. Mus. Hamburg. XVII. 1900.

1908. —— Anthozoa. BRONN's Klassen u. Ordn. des Tierreichs. II, 2. 1903—1908.

1891. CERFONTAINE, P. Sur l'organisation et le développement de differentes formes d'Anthozoaires. Bull. Acad. Roy. Belgique. Ser. 3. XXII. 1891.

1909. —— Contributions a l'étude des Cérianthides. Nouvelles recherches sur le Cerianthus oligopodus (Cerf). Arch. de Biol. XXIV. 1909.

1830. DELLA CHIAJE, S. Memorie sulla Storia e Notomia degli animali senza Vertebre del Regno di Napoli. Napoli. 1822—1830.

1860. DANIELSSEN, D. C. Om Cerianthus borealis n. sp. Forh. vidensk. Selsk. Christiania. 1860.

1902. DUERDEN, J. E. West Indian Madreporarian Polyps. Mem. Nat. Acad. Sci. Washington. VIII. 1902.

1902[1]. —— The Morphology of the Madreporaria. II. Increase of Mesenteries in Madrepora beyond the Protocnemic stage. Ann. and Mag. Nat. Hist. Ser. 7. X. 1902.

1905. —— The Morphology of the Madreporaria. VI. The Fossula in Rugose Corals. Biolog. Bull. IX. 1905.

1891. FAUROT, L. Sur le Cerianthus membranaceus (Gmelin). Mem. Soc. Zool. de France. IV. 1891.

1895. —— Études sur l'anatomie, l'histologie et le développement des Actinies. Arch. Zool. Expér. et Gén. Ser. 3. III. 1895.

1889. FISCHER, P. Sur la disposition des tentacules chez les Cérianthes. Bull. Soc. Zool. de France. XIV. 1889.

1843. FORBES, E. On the genus Edwardsia, with descriptions of new species. Ann. and Mag. Nat. Hist. Ser. I. XII. 1843.

1897. FOWLER, G. H. The later development of Arachnactis albida (M. Sars), with notes on Arachnactis bournei (sp. n.). Proc. Zool. Soc. London. 1897.

1788. GMELIN, J. F. LINNÉ's Systema Naturæ. Ed. XIII. Lipsiæ. 1788—1793.

1860. GOSSE, P. H. Actinologia Britannica. London. 1860.

1902. GRAVIER, CH. Sur un Cérianthaire pélagique adulte. Comptes Rendus Acad. Sci. Paris. CXXXV. 1902.

1904. —— Recherches sur un Cérianthaire pélagique adulte du Golfe de Californie (Dactylactis benedeni n. sp.). Ann. Sci. Nat. Ser. 8. Zool. XX. 1904.

1840. GRUBE, A. E. Actinien, Echinodermen und Würmer des Adriatischen- und Mittelmeeres. Königsberg. 1840.

1894. HADDON, A. C. and SHACKLETON, ALICE M. Description of some new species of Actiniaria from Torres Straits. Scient. Proc. Roy. Dublin Soc. N. S. VIII. 1894.

1854. HAIME, J. Mémoire sur le Cérianthe. Ann. Sci. Nat. Zool. Ser. 4. I. 1854.

1885. HASWELL, W. A. On a new instance of Symbiosis. Proc. Linnean Soc. New South Wales. IX. 1885.

1879. VON HEIDER, A. R. Cerianthus membranaceus Haime. Ein Beitrag zur Anatomie der Actinien. Sitsber. k. k. Acad. Wien. Math.-Naturwiss. Classe. LXXIX. 1879.

1879. HERTWIG, O. and R. Die Actinien. Jenaische Zeitschr. XIV. 1879.

1882. HERTWIG, R. Report on the Actinaria. Reports Sci. Res. Voyage H. M. S. Challenger. Zool. VI. 1882.

1830. ILMONI, J. Beiträge zur Naturgeschichte der Actinien. Isis. XXIII. 1830.

1904. KINGSLEY, J. S. Description of Cerianthus borealis Verrill. Tufts College Studies. N° 8. 1904.

1898. KWIETNIEWSKI, C. R. Actiniaria von Ambon und Thursday Island. Jenaische Denkschr. V. 1898.

1893. LEVINSEN, G. M. R. Anthozoen. Det vidensk. Udbytte af Kanonb. Hauchs Togter. V. 1893.

1890. MC INTOSH, W. C. Notes from St. Andrews Marine Laboratory, XI. Ann. and Mag. Nat. Hist. Ser. 6. V. 1890.

1890. MC MURRICH, J. P. Contributions on the Morphology of the Actinozoa, I. The Structure of Cerianthus americanus. Journ. of Morph. IV. 1890.

1891. —— Contributions on the Morphology of the Actinozoa. III. The Phylogeny of the Actinozoa. Journ. of Morph. V. 1891.

1893. —— Report on the Actiniæ collected by the United States Fish Commission Steamer Albatross during the Winter of 1887—1888. Proc. U. S. Nat. Museum. XVI. 1893.

1852. MILNE-EDWARDS, H. and HAIME, J. Monographie des Polypiers fossiles. Arch. du Muséum. V. 1852.

1857. MILNE-EDWARDS, H. Histoire naturelle des Coralliaires ou Polypes proprement dits. Paris. 1857.

1877. MOSELY, H. N. On new forms of Actiniaria dredged in the deep sea. Trans. Linnean Soc. London. Ser. 2. I. 1877.

1829. RAPP, W. Über die Polypen im Allgemeinen und die Actinien insbesondere. Weimar. 1829.

1847. RENIER, S. A. Osservazioni postume di zoologica Adriatica per cura di Meneghini. Venezia. 1847.

1904. ROULE, L. Sur un Cerianthaire nouveau. Comptes Rendus Acad. Sci. Paris. CXXXVIII. 1904.

1905. —— Description des Antipathaires et Cérianthaires recueillis par S. A. S. le Prince de Monaco dans l'Atlantique nord (1896—1902). Res. des Campagnes Sci. par ALBERT Ier, Prince Souverain de Monaco. Fasc. XXX. 1905.

1846. SARS, M. Über Arachnactis albida, einen schwimmenden Polypen. Fauna littoralis Norvegiæ. I. 1846.

1861. —— Beretning om en i Sommeren 1859 foretagen zoologisk Reise ved Kysten af Romsdals Amt. Nyt. Mag. for Naturv. XI. 1861.

1882. SCUDDER, H. S. Nomenclator zoologicus. 1882.

1907. SENNA, A. Larve pelagiche di Attiniari. Racc. planktoniche fatte dalle R. nave Liguria. I. 3. Firenze. 1907.

1784. SPALLANZANI, L. Diversi animali nuovi. Mem. Soc. Ital. di Verona. II. 1784.

1909. TORREY, H. B. and KLEEBERGER, F. L. Three Species of Cerianthus from Southern California. University of California Publications. Zool. VI. 1909.

1895. VANHÖFFEN, E. Untersuchungen über Anatomie und Entwicklungsgeschichte von Arachnactis albida Sars. Biblioth. Zool. XX. 1895.

1873. VERRILL, A. E. Results of Recent Dredging Expeditions on the Coast of New England. Amer. Journ. Sci. Ser. 3. V. 1873.

1898. —— Descriptions of New American Actinians, with critical Notes on other Species. I. Amer. Journ. Sci. VI. 1898.

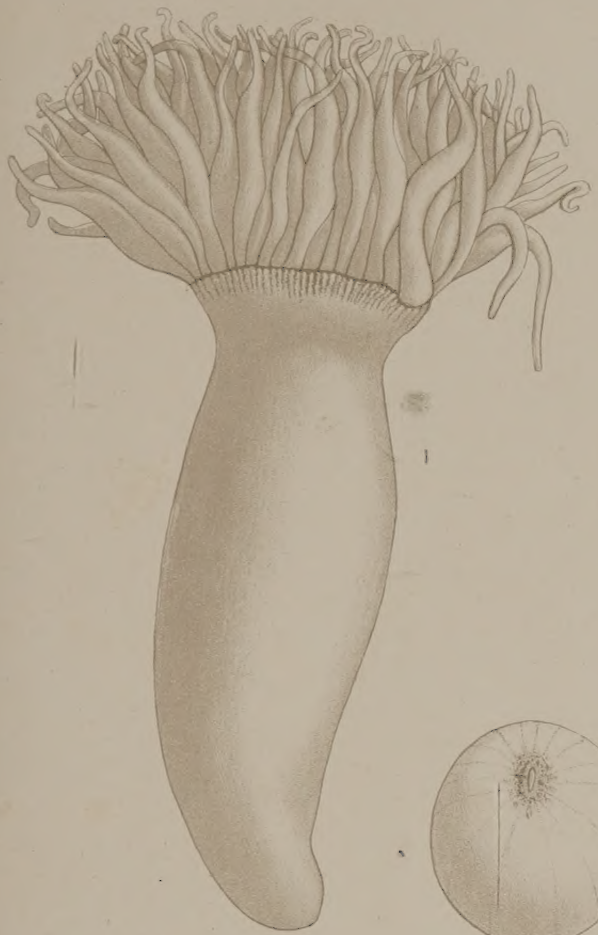
1888. VOGT, C. Des genres Arachnactis et Cerianthus. Arch. de Biol. VIII. 1888.

1888. WILSON, H. V. On the Development of Manicina areolata. Journ. of Morph. II. 1888.

EXPLANATION OF PLATES

PLATE I.

Fig. 1. — *Cerianthus ambonensis*. Station 181, Ambon I. Natural size.
Fig. 2. — *Cerianthus sulcatus*. Station 181, Ambon I. Natural size.
Fig. 3. — *Cerianthus tædus*. Station 85. Natural size.
Fig. 4. — *Apiactis obconica*. Station 172. × 5.
Fig. 5. — *Apiactis obconica*. Station 165. × 10.
Fig. 6. — *Peponactis pilula*. Station 96. × 10.
Fig. 7. — *Pachycerianthus fimbriatus*. Station 181, Ambon I. Natural size.
Fig. 8. — *Pachycerianthus monostichus*. Station 181, Ambon I. Natural size.
Fig. 9. — *Arachnactis sibogæ*. Station 205. × 10.
Fig. 10. — *Arachnactis sibogæ*. Station 205bis. × 10.
Fig. 11. — *Dactylactis malayensis*. Station 172. × 5.
Fig. 12. — Trilobed portion of a mesenterial filament of *C. fimbriatus*. *DL.* = distal lobe; *gl.* = gland cell; *M.* = median streak; *n.* = nematocyst; *PL.* = proximal lobe. × 200.
Fig. 13. — Section of craspedoneme of *P. fimbriatus*. *en.* = endoderm; *DL.* = distal lobe; *PL* = proximal lobe. × 200.
Fig. 14. — Section of craspedoneme of *C. americanus*. × 200.
Fig. 15. — Section of the simple portion of a mesenterial filament of *P. fimbriatus*. × 200.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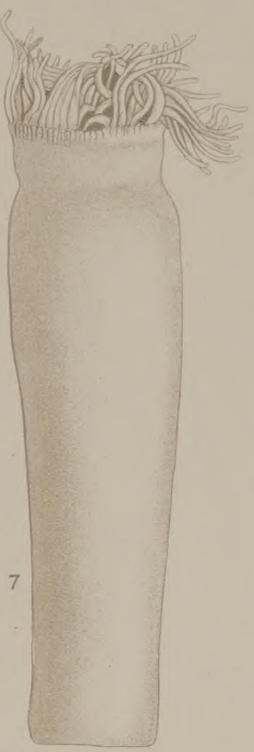
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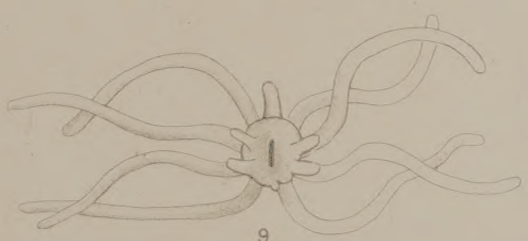
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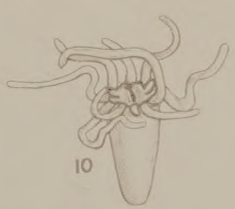
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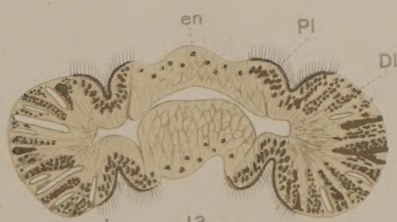

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J. Playfair Mc Murrich del.